



## APOLLO TRAINING

APOLLO SPACECRAFT & SYSTEMS  
FAMILIARIZATION

COURSE NUMBER  
APC-118

AUGUST 15, 1967

FOR TRAINING PURPOSES ONLY



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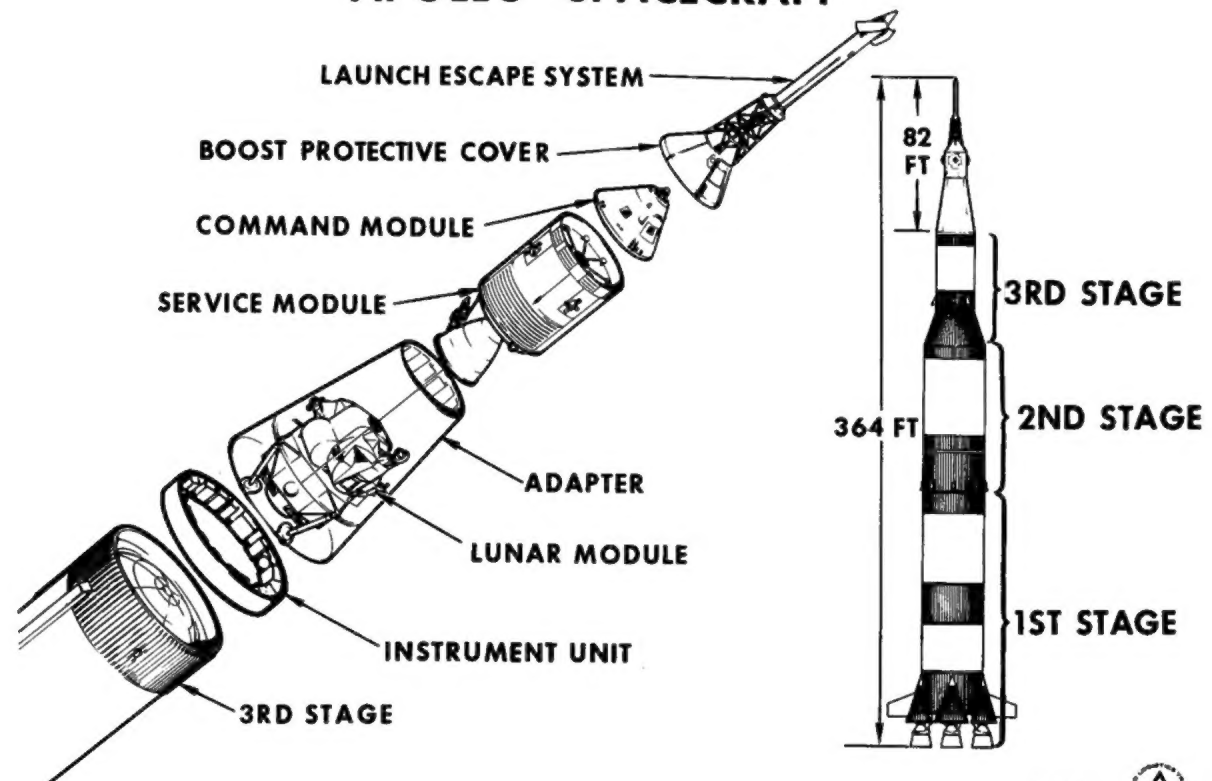
QUESTIONS RELATIVE TO THE CONTENTS OF THIS  
DOCUMENT SHOULD BE DIRECTED TO:


S.I. JIMENEZ  
B.C. GROVER  
NAA, SPACE DIVISION  
DOWNEY, CALIFORNIA  
EXTENSION 4325,6 OR 7

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## APOLLO SPACECRAFT



FAM-1027 

## NAA APOLLO SUBCONTRACTORS (CONT)

### SYSTEM/COMPONENTS

### CONTRACTOR

#### PROPULSION

CM REACTION CONTROL ENGINES.....ROCKETDYNE DIV OF NAA - CANOGA PARK, CALIF.  
 SM REACTION CONTROL ENGINES.....MARQUARDT CORP - VAN NUYS, CALIF.  
 POSITIVE EXPULSION TANKS (RCS).....BELL AEROSYSTEMS - BUFFALO, N.Y.  
 HELIUM TANKS.....AIRITE PRODUCTS - LOS ANGELES, CALIF.  
 FUEL & OXIDIZER TANKS (SPS).....ALLISON DIV OF GMC - INDIANAPOLIS, IND.  
 PROPELLANT GAGING & MIXTURE RATIO CONTROL.....SIMMONDS PRECISION PROD - TARRYTOWN, N.Y.  
 SERVICE PROPULSION ENGINE.....AEROJET GENERAL - SACRAMENTO, CALIF.

#### COMMUNICATIONS & DATA.....COLLINS RADIO CO.-CEDAR RAPIDS, IOWA

BEACON ANTENNA (R&D).....MELPAR - FALLS CHURCH, VA.  
 C-BAND ANTENNA.....RADCOM - COLLEGE PARK, MD.  
 CENTRAL TIMING SYSTEM.....GENERAL TIME - ROLLING MEADOWS, ILL.  
 HF ANTENNAS (RECOVERY & ORBITAL).....DEHAVILLAND - ONTARIO, CANADA  
 DIGITAL UP-DATA LINK.....MOTOROLA, INC. - SCOTTSDALE, ARIZ.  
 VHF ANTENNA.....LOS ANGELES DIV OF NAA - INGLEWOOD, CALIF.  
 TV CAMERA.....RCA - PRINCETON, N.J.  
 2 KMC HI GAIN ANTENNA.....DALMO - VICTOR - BELMONT, CALIF.

#### MISSION SIMULATOR TRAINER.....GIP-LINK DIV - BINGHAMTON, N.Y.

#### SYSTEMS INTEGRATED TEST EQUIPMENT.....AUTONETICS DIV OF NAA - ANAHEIM, CALIF.

# NAA APOLLO SUBCONTRACTORS

## SYSTEM/COMPONENTS

## CONTRACTOR

### STRUCTURES

ABLATIVE MATERIAL FOR HEAT SHIELD.....AVCO CORP-WILMINGTON, MASS.  
BOOST COVER, LES TOWER, DOCKING PROBE, CANARDS  
RADIAL BEAMS, FWD HEAT SHIELD & CREW COUCHES.....LOS ANGELES DIV OF NAA - INGLEWOOD, CALIF.  
STAINLESS STEEL HONEY COMB PANELS .....AERONCA MFG CO - MIDDLETOWN, OHIO

### ELECTRICAL POWER

BATTERIES ("A", "B" & "C").....EAGLE PICHER - JOPLIN, MO.  
BATTERY CHARGER.....ITT - INDUSTRIAL PRODUCTS DIV - SAN FERNANDO, CALIF.  
FUEL CELL MODULES.....PRATT & WHITNEY - EAST HARTFORD, CONN.  
STATIC INVERTERS.....WESTINGHOUSE ELECTRIC CORP - LIMA, OHIO  
CRYOGENIC GAS STORAGE.....BEECH AIRCRAFT - BOULDER, COLO.

ENVIRONMENTAL CONTROL .....AIRESEARCH MFG CO - LOS ANGELES, CALIF.

### SEQUENTIAL EVENTS CONTROL

MASTER EVENT SEQUENCE CONTROLLER.....AUTONETICS DIV OF NAA - ANAHEIM, CALIF.  
LAUNCH ESCAPE & PITCH CONTROL MOTORS.....LOCKHEED PROPULSION CO - REDLANDS, CALIF.  
TOWER JETTISON MOTOR .....THIOKOL CHEMICAL CORP - ELKTON, MD.  
EARTH LANDING PARACHUTE SUBSYSTEM .....NORTHROP - VENTURA - NEWBERRY PARK, CALIF.

STABILIZATION & CONTROL.....HONEYWELL CORP - MINNEAPOLIS, MINN.

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### SYSTEM/COMPONENTS

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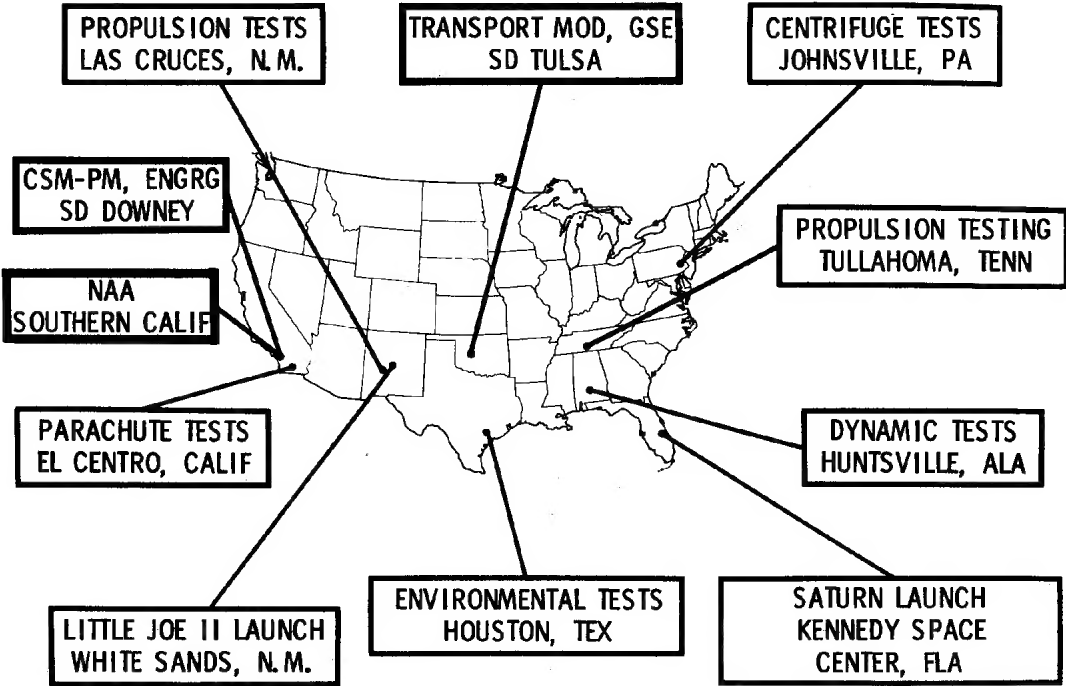
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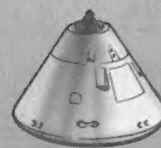
# FACILITIES-NATIONWIDE





# APOLLO SPACECRAFT SPACE DIVISION RESPONSIBILITIES

597AP83027E



CM



SM



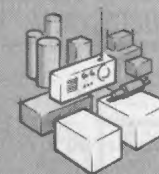
LEM



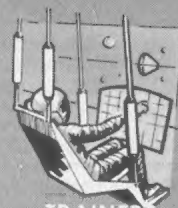
SLA



GSE



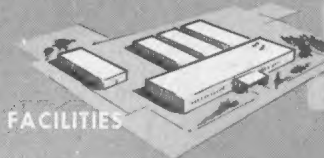
SPARES



TRAINERS



MAJOR SUBS



FACILITIES



TEST SITE  
ACTIVATION

(NAA ALSO INTERFACES WITH ASSOCIATE CONTRACTORS FOR GUID-  
ANCE & NAVIGATION, ACCEPTANCE CHECKOUT EQUIPMENT, LUNAR  
MODULE, ETC.)

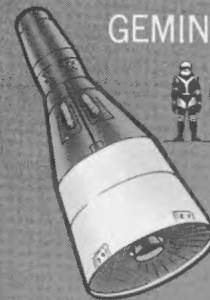
# MANNED SPACECRAFT

S47ASD10175D

MERCURY



GEMINI

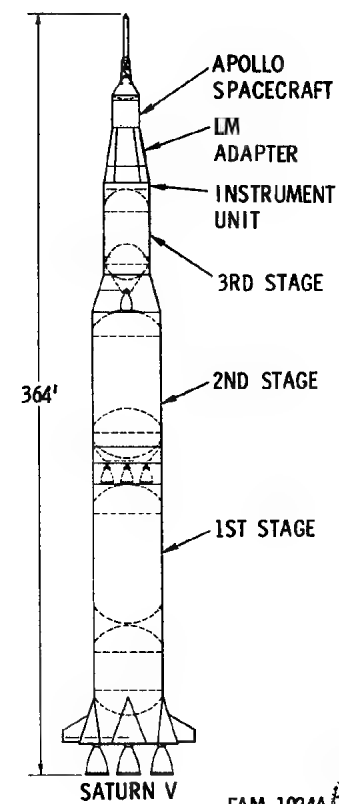
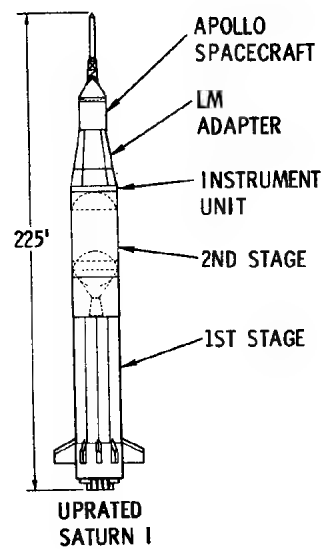


APOLLO

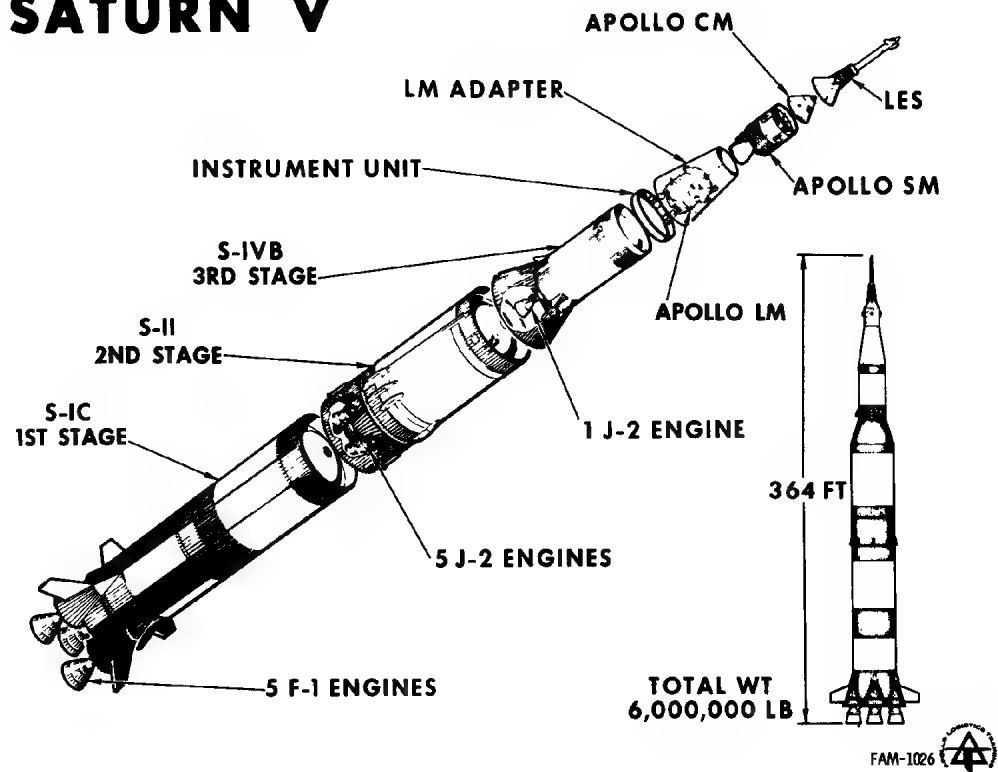


	MERCURY	GEMINI	APOLLO
PAYLOAD, LBS			
EARTH ORBITAL	3,500	7,000	250,000
TRANSLUNAR	—	—	94,000
BOOSTER	ATLAS	TITAN II	SATURN V
THRUST, LBS	360,000	430,000	7,500,000

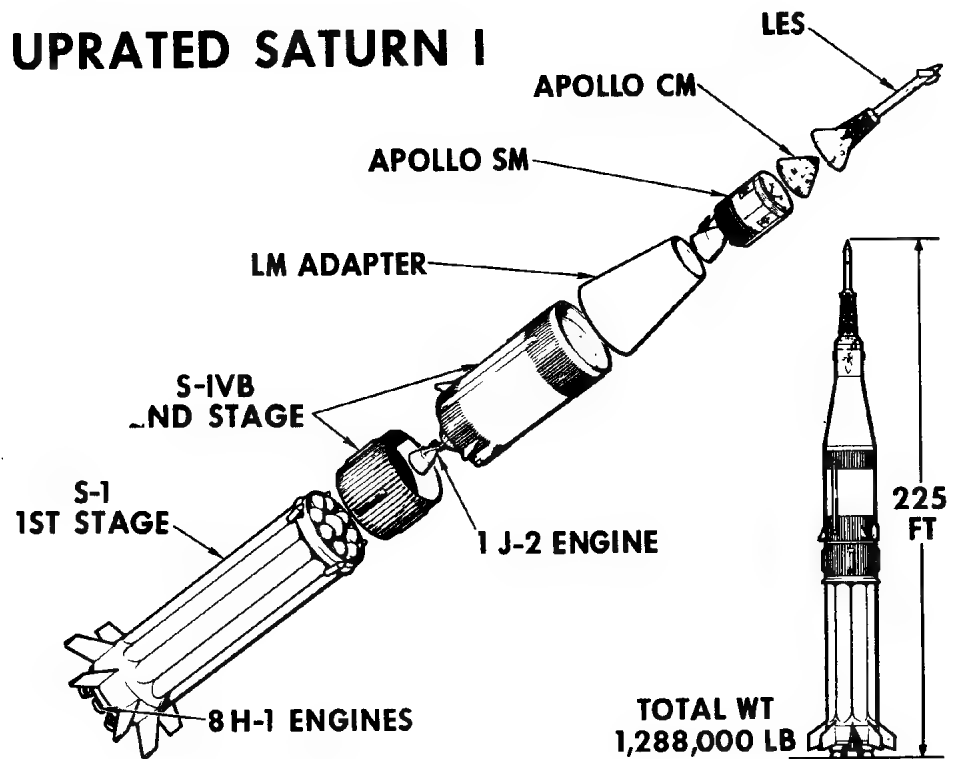
## APOLLO LAUNCH VEHICLES




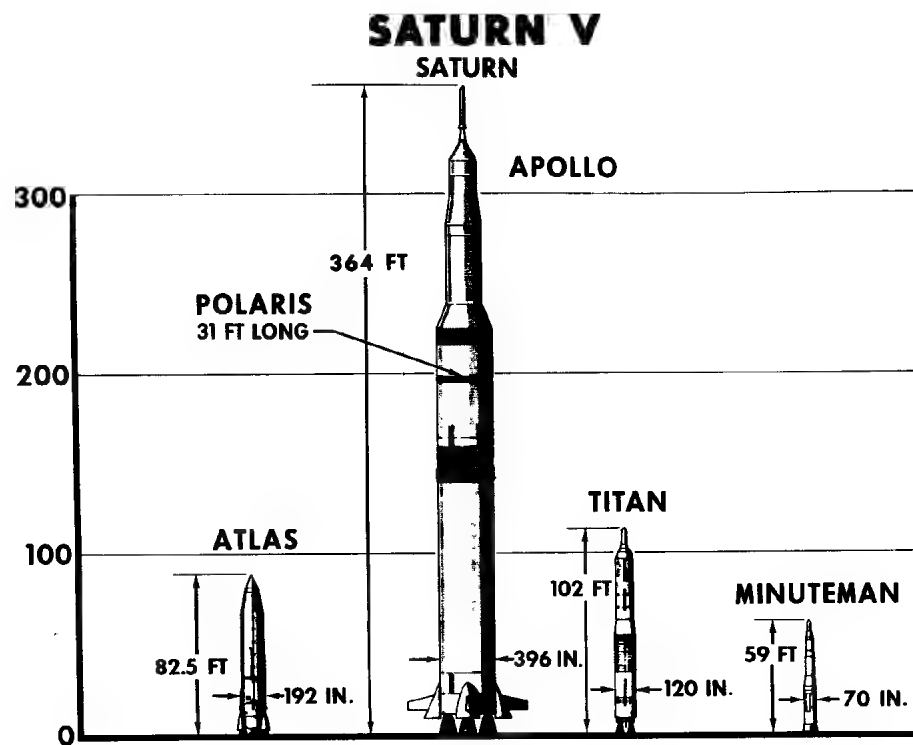
# SATURN V



# UPDATED SATURN I



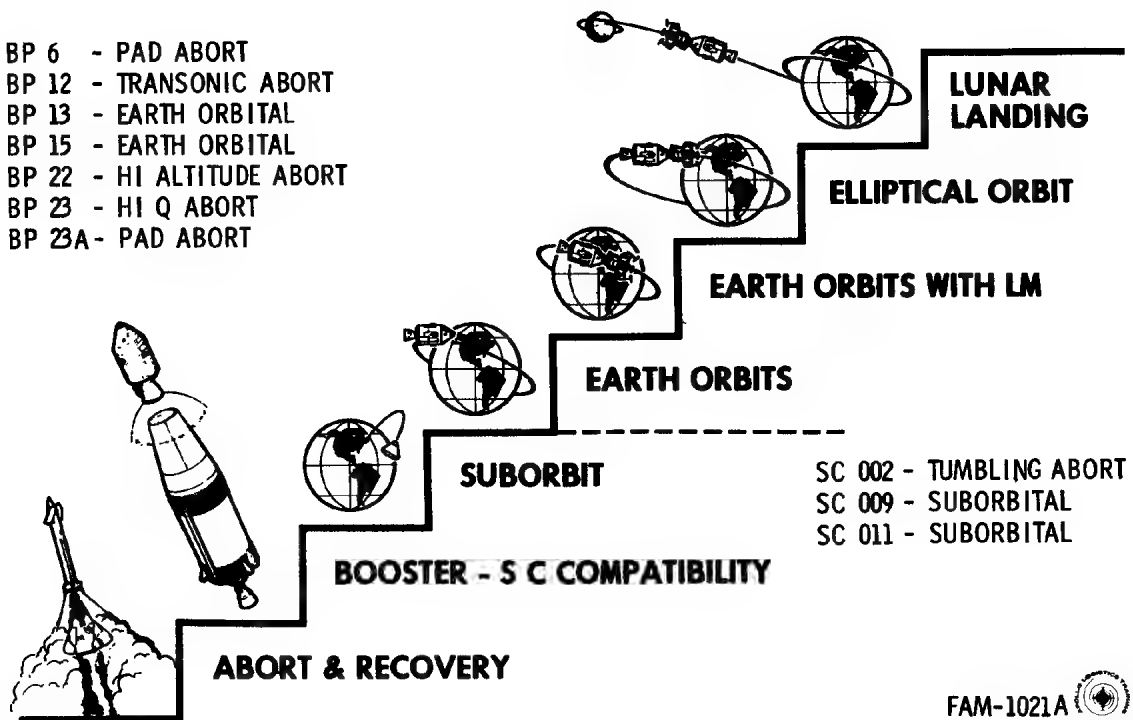
FAM-1025 



# SPACECRAFT DEVELOPMENT FLIGHT CATEGORIES

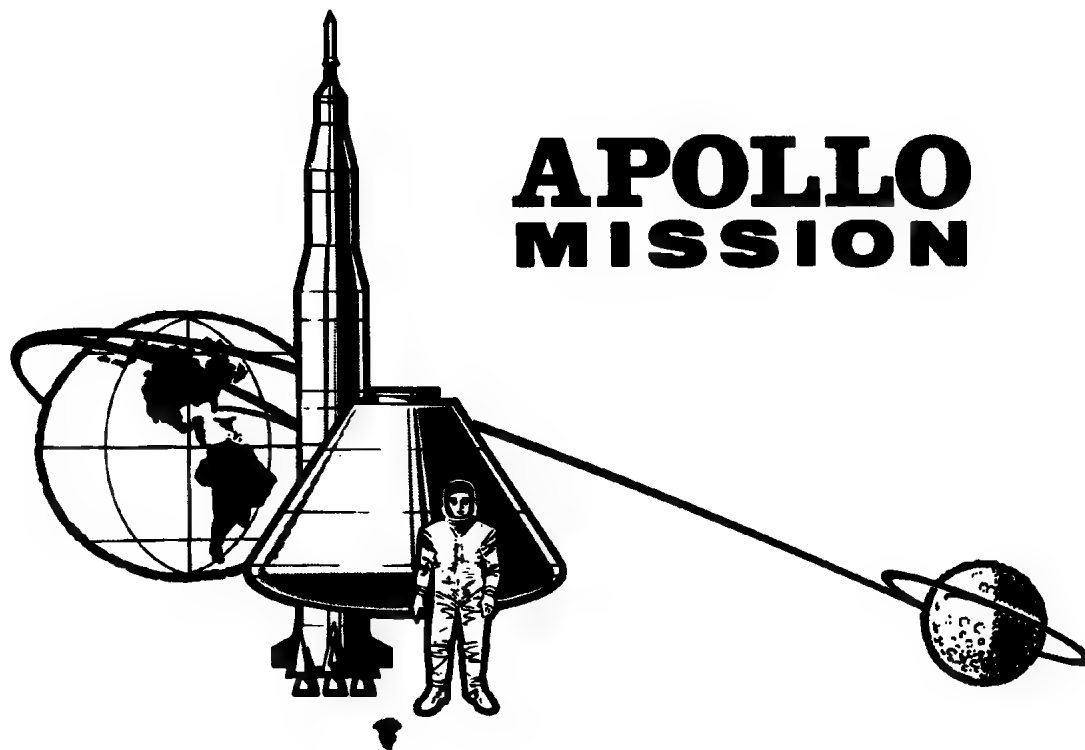
## MAJOR STEPS TO ULTIMATE MISSION

BP 6 - PAD ABORT  
 BP 12 - TRANSONIC ABORT  
 BP 13 - EARTH ORBITAL  
 BP 15 - EARTH ORBITAL  
 BP 22 - HI ALTITUDE ABORT  
 BP 23 - HI Q ABORT  
 BP 23A - PAD ABORT



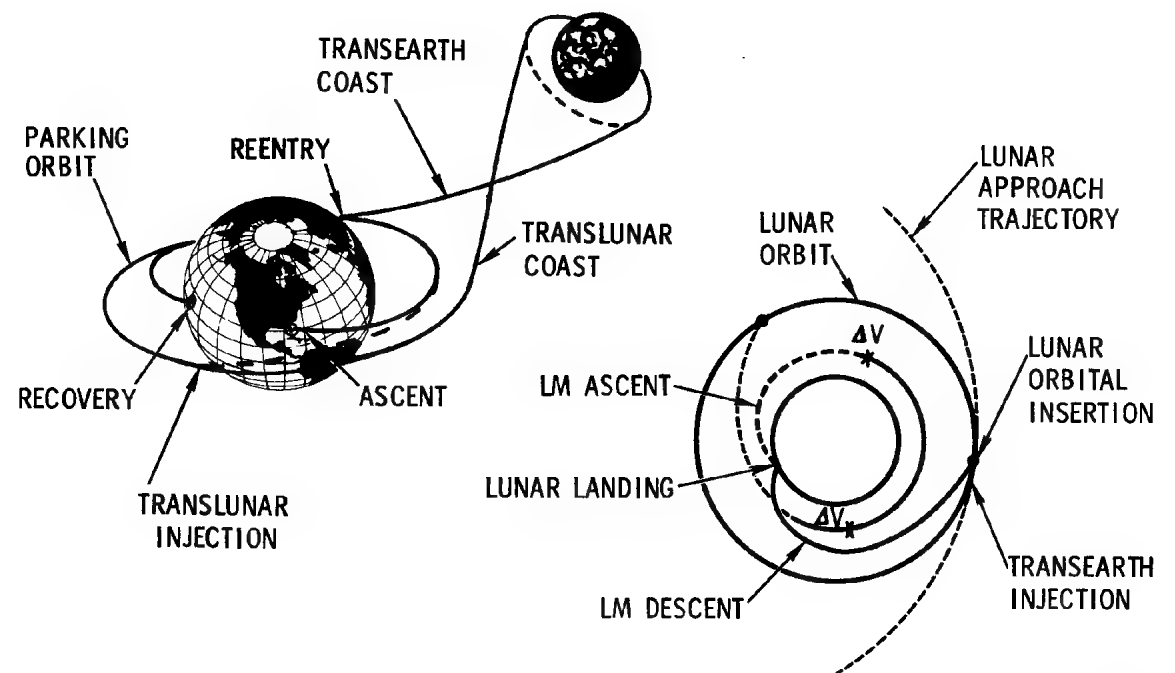
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# APOLLO MISSION





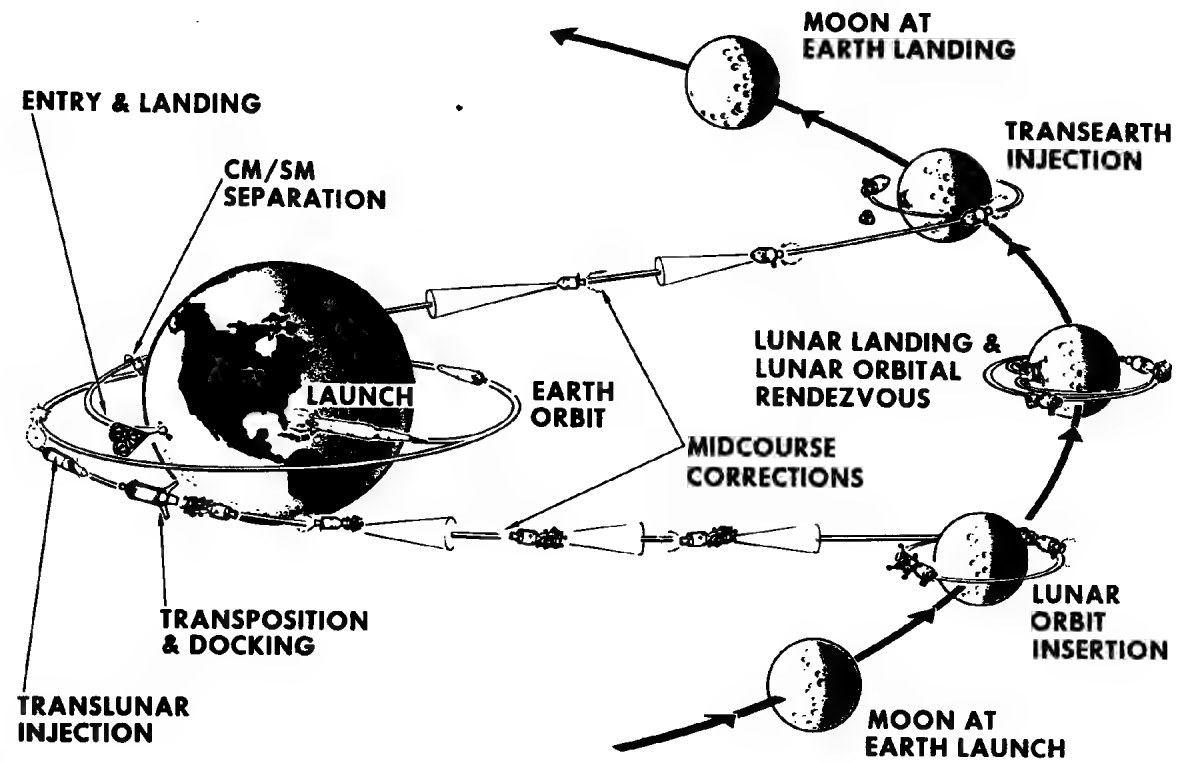
# LUNAR MISSION

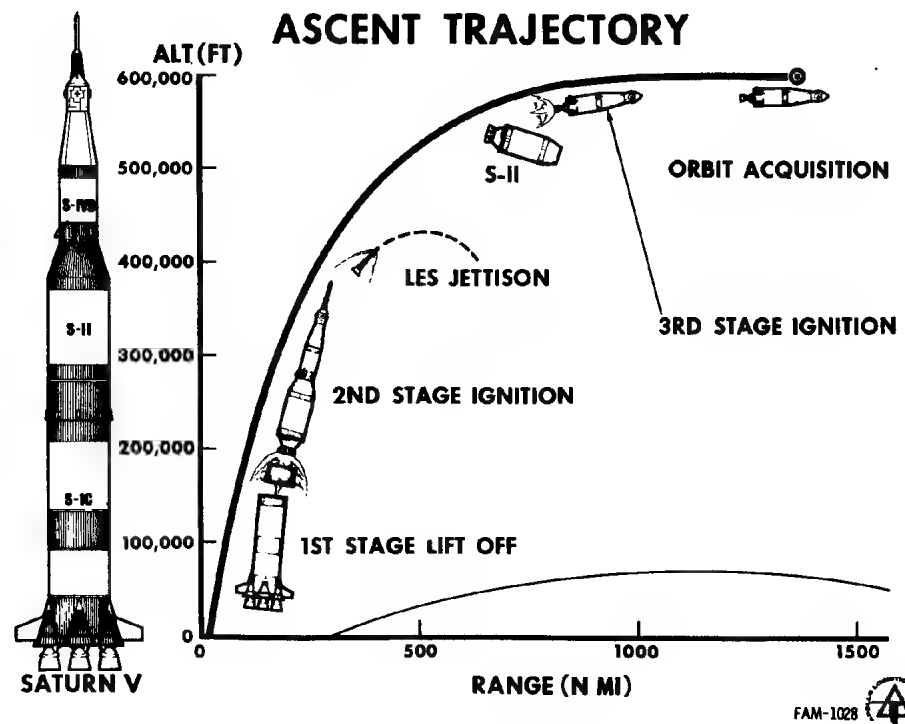


# APOLLO MISSION PLAN

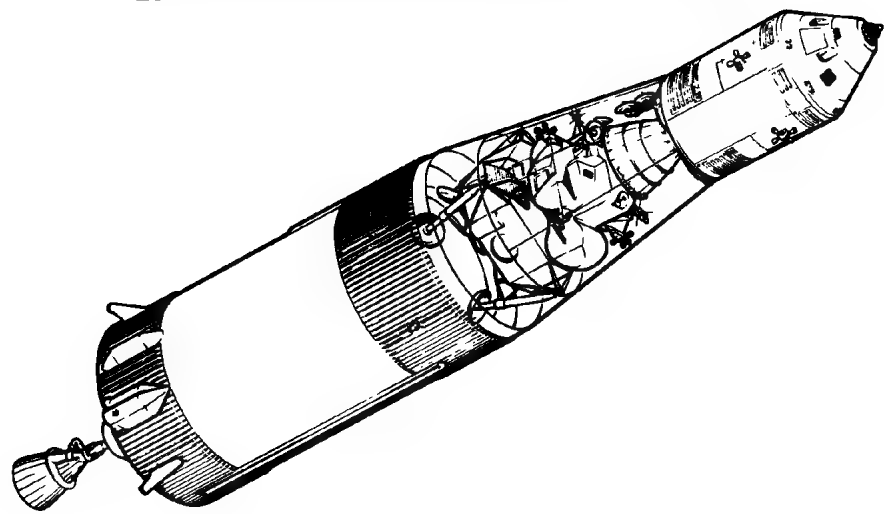
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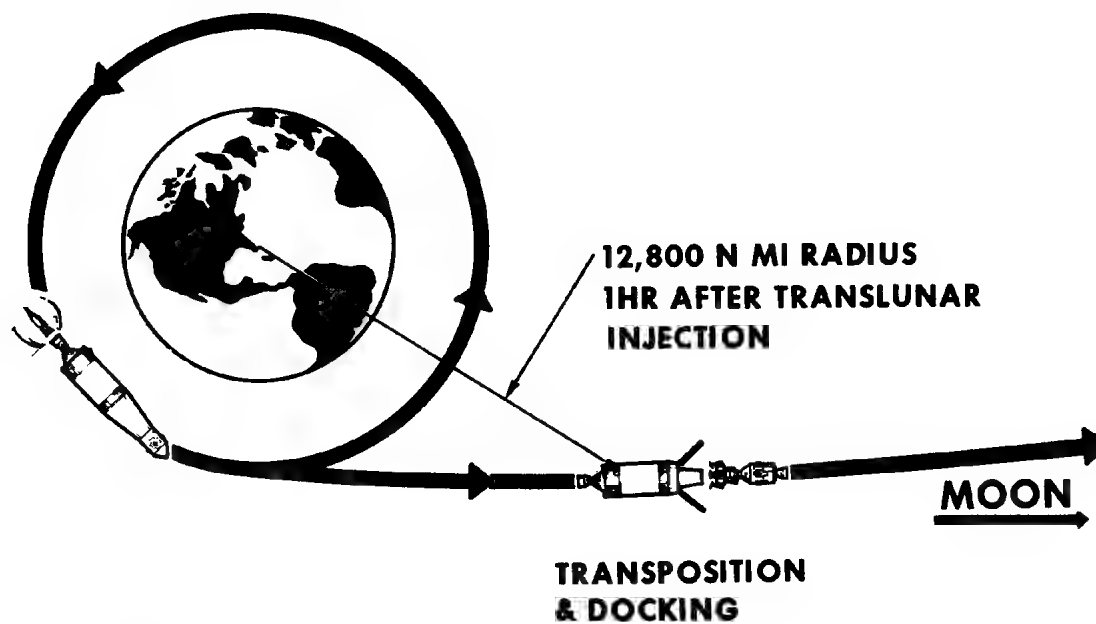




**APOLLO SPACECRAFT/3RD STAGE  
EARTH ORBITAL CONFIGURATION**

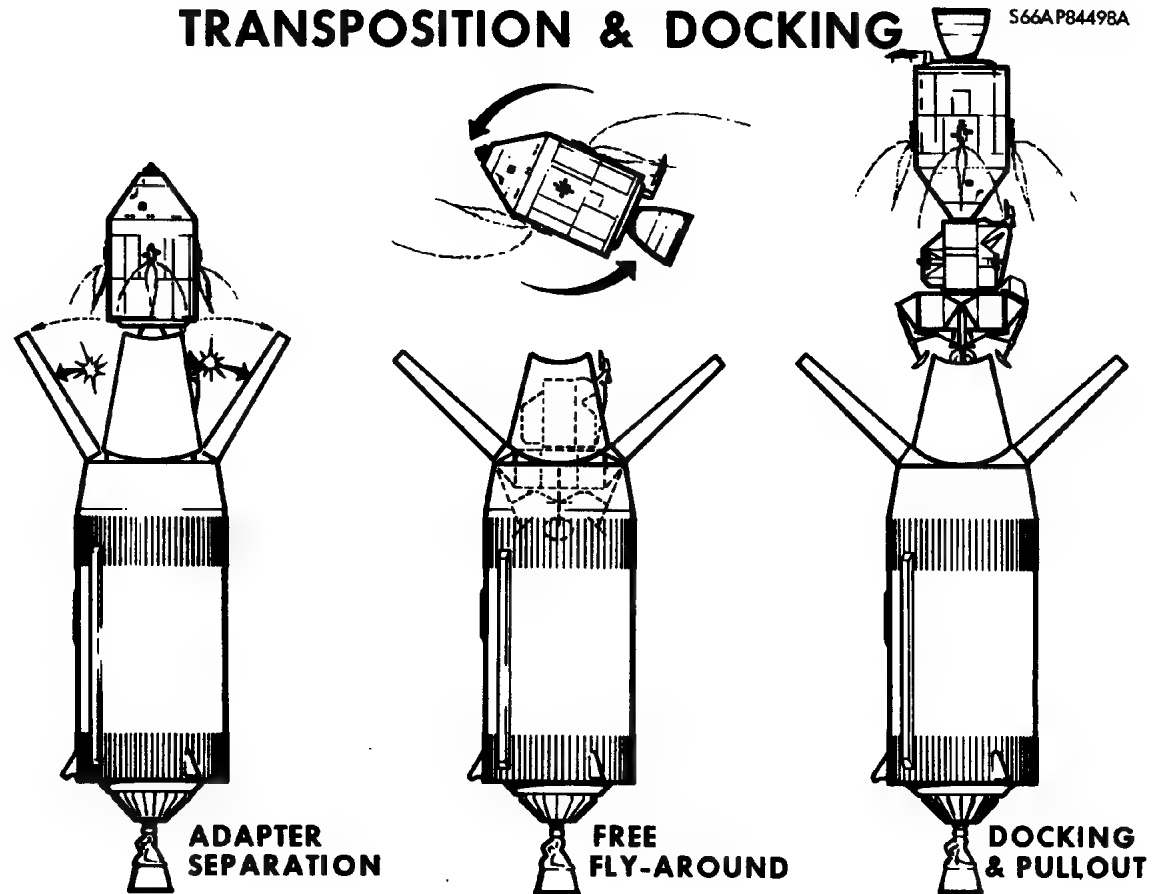


## TRANSLUNAR INJECTION & COAST



# TRANSPOSITION & DOCKING

S66AP84498A



# APOLLO SPACECRAFT TRANSLUNAR CONFIGURATION

S47AP84497B

EVA HANDLES





# PROPOSED LUNAR LANDING

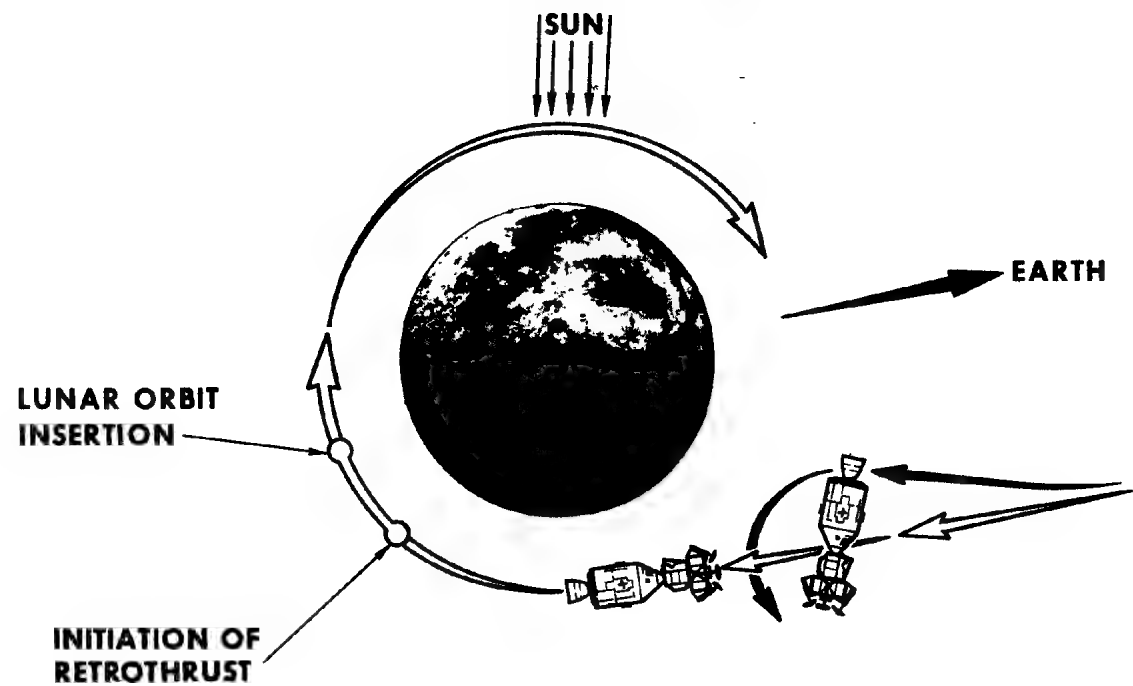
 RANGER  
IMPACTS  
 SURVEYOR

FAM-1022 



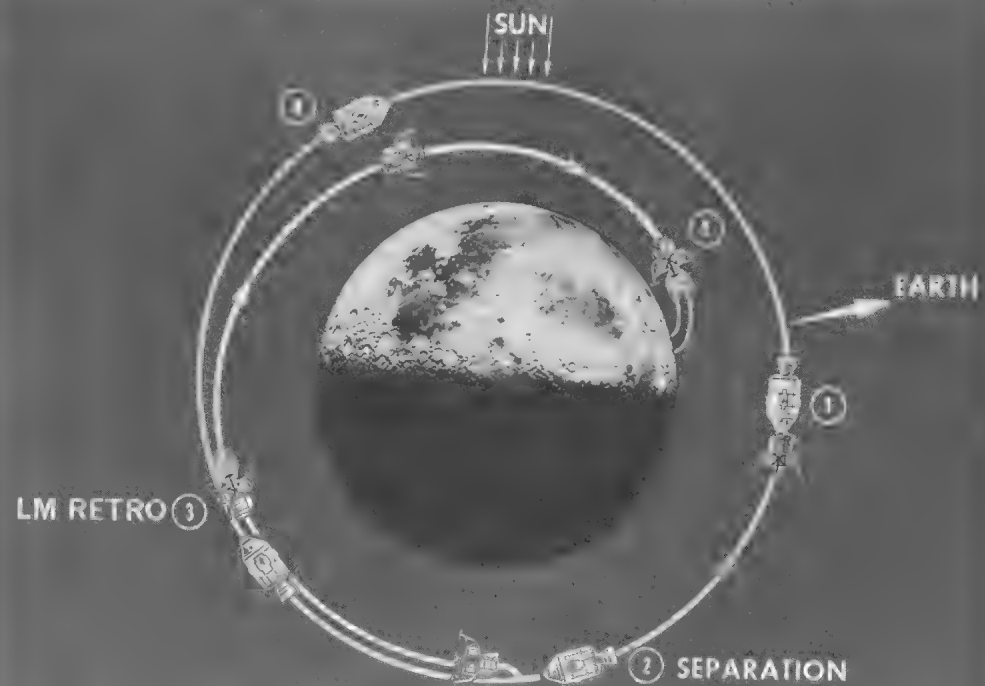
# LUNAR ORBIT INSERTION

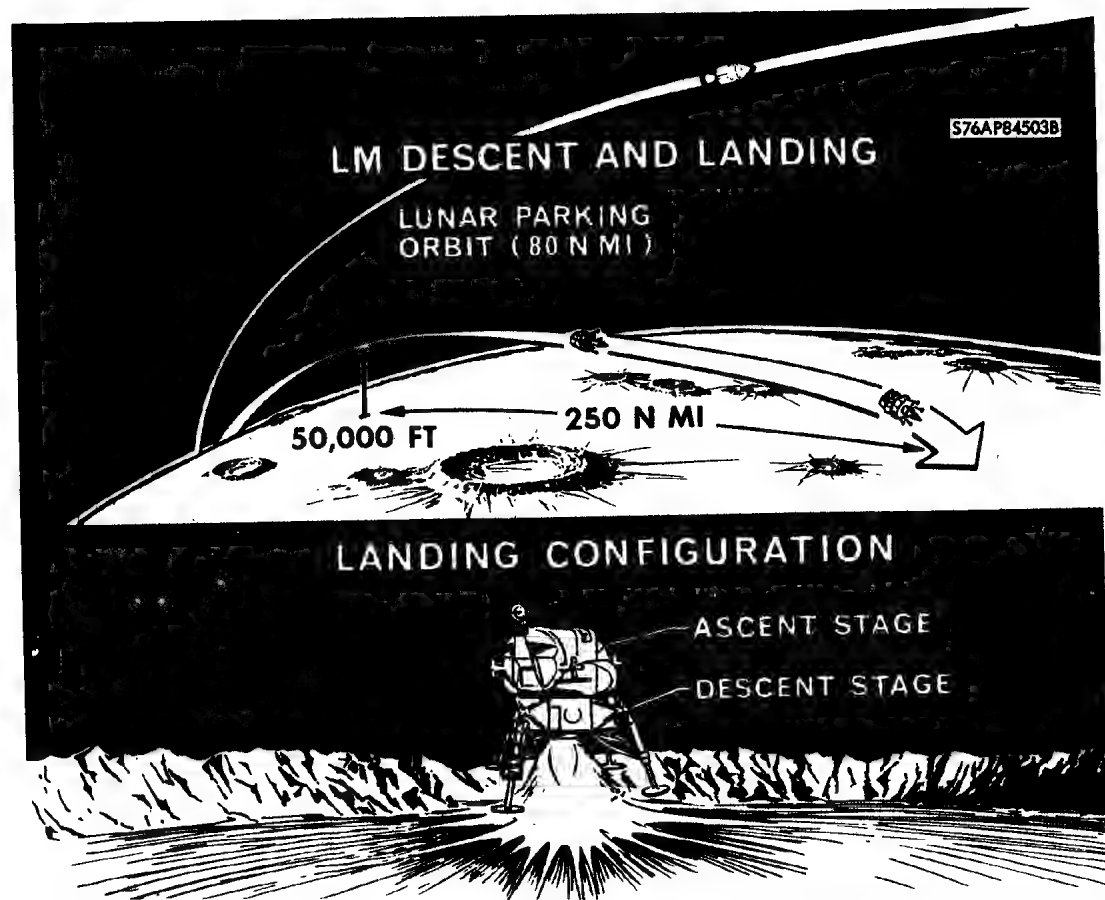
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# LM SEPARATION & DESCENT

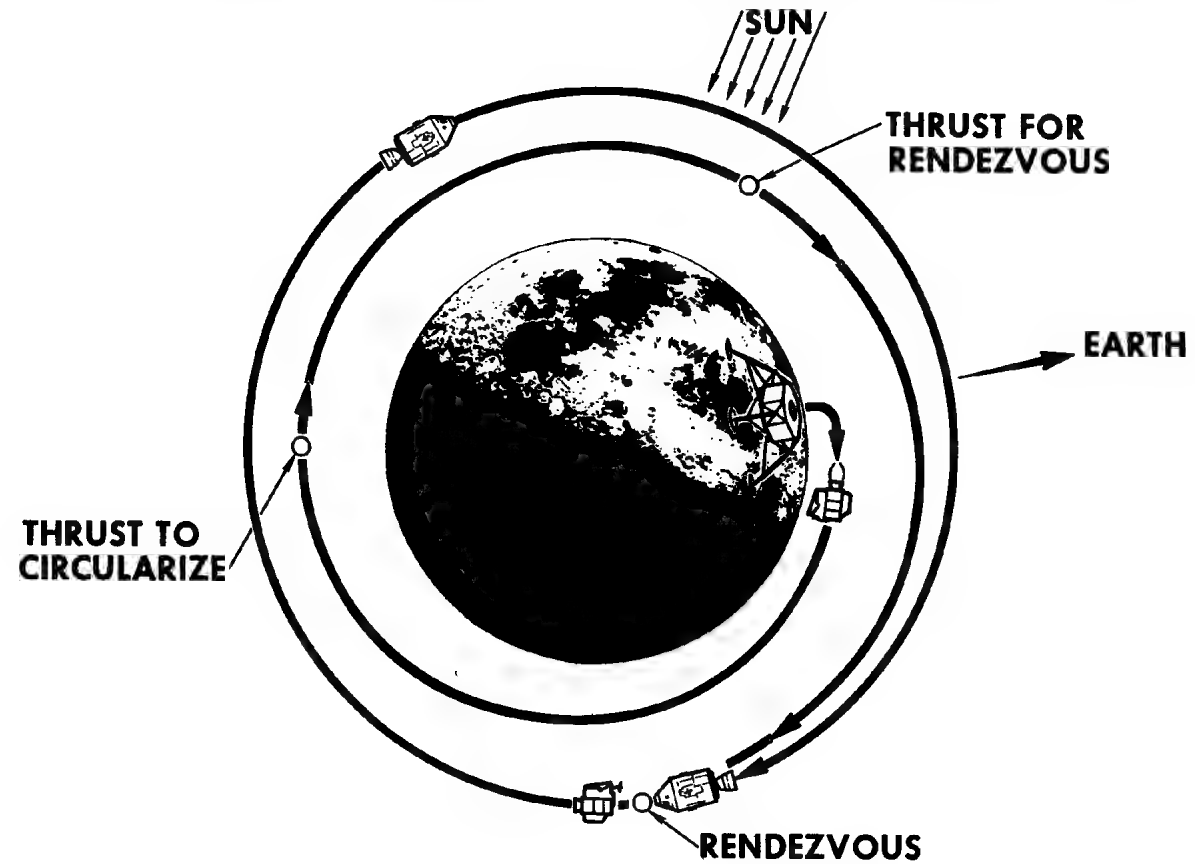
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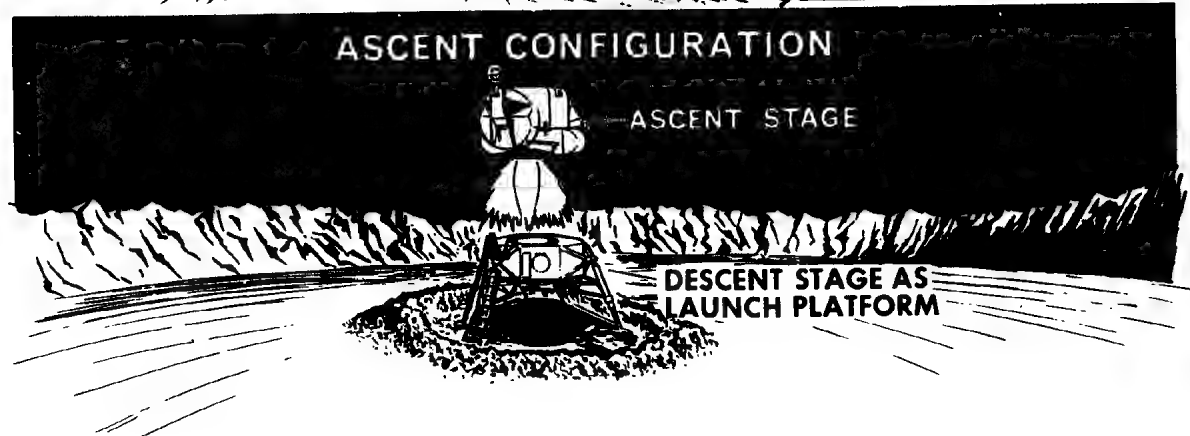
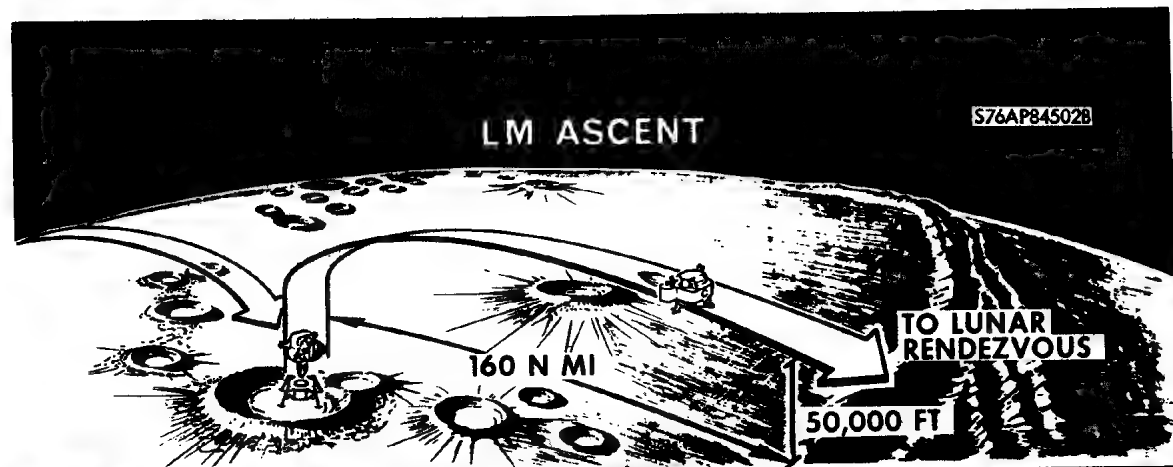




# LUNAR ORBITAL RENDEZVOUS

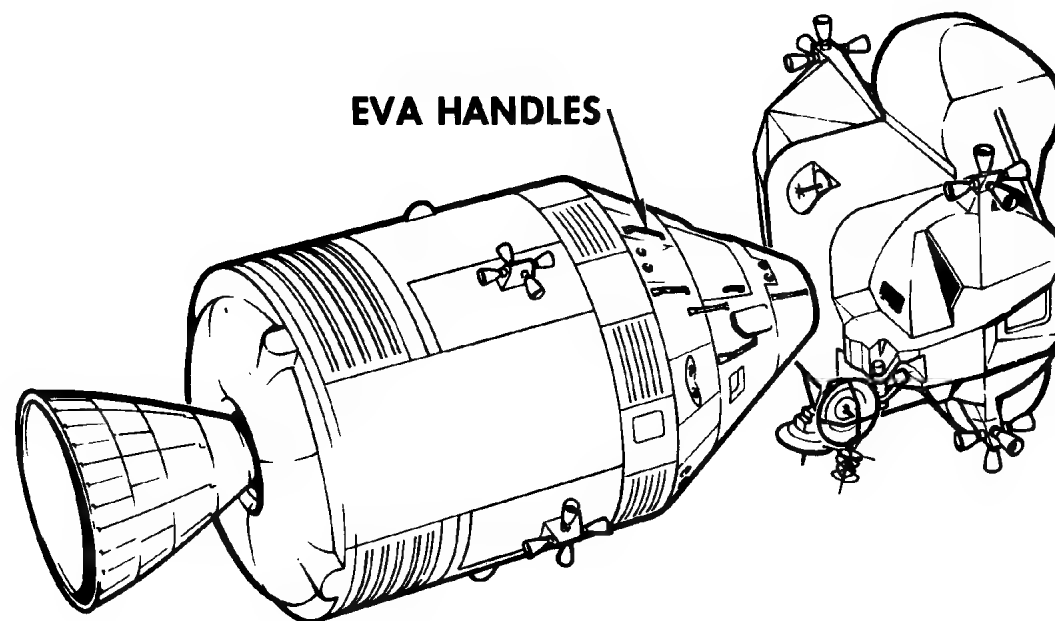
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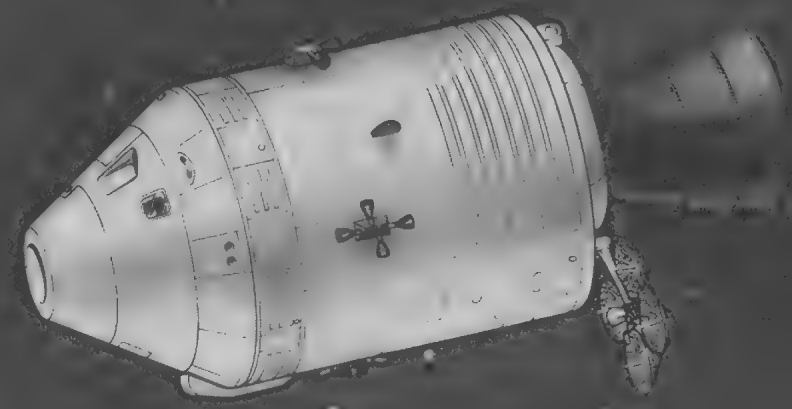
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## APOLLO SPACECRAFT LOR CONFIGURATION

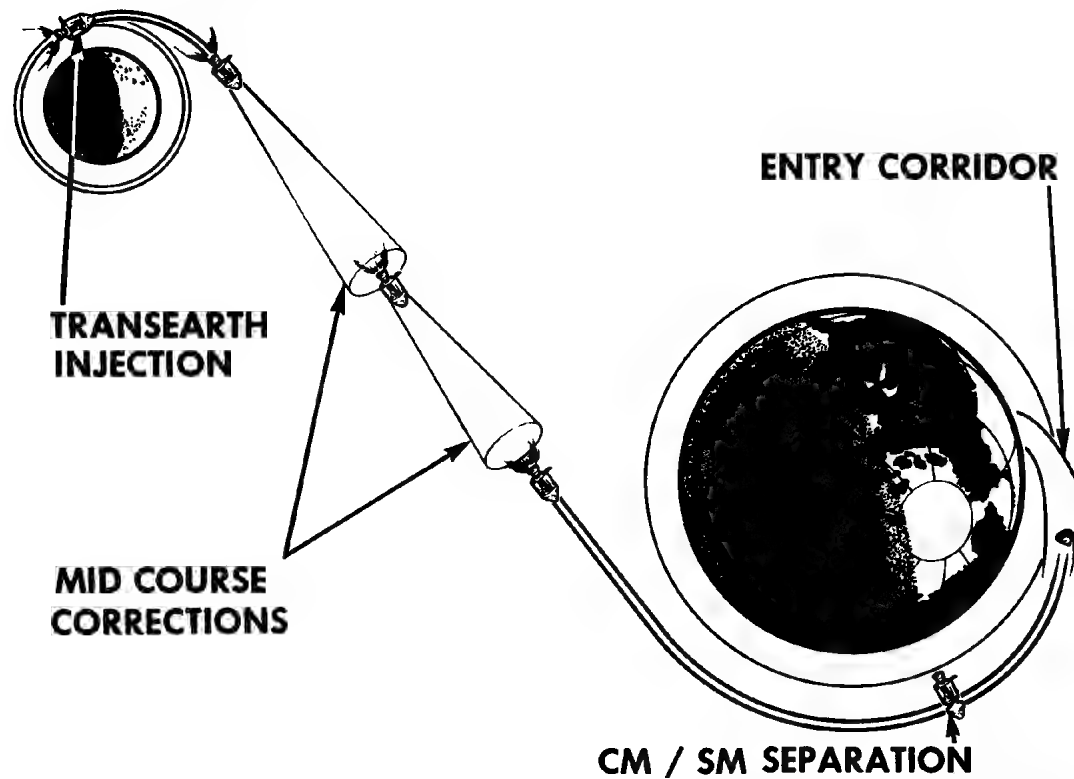


S47A-P93078B

# APOLLO TRANSEARTH CONFIGURATION

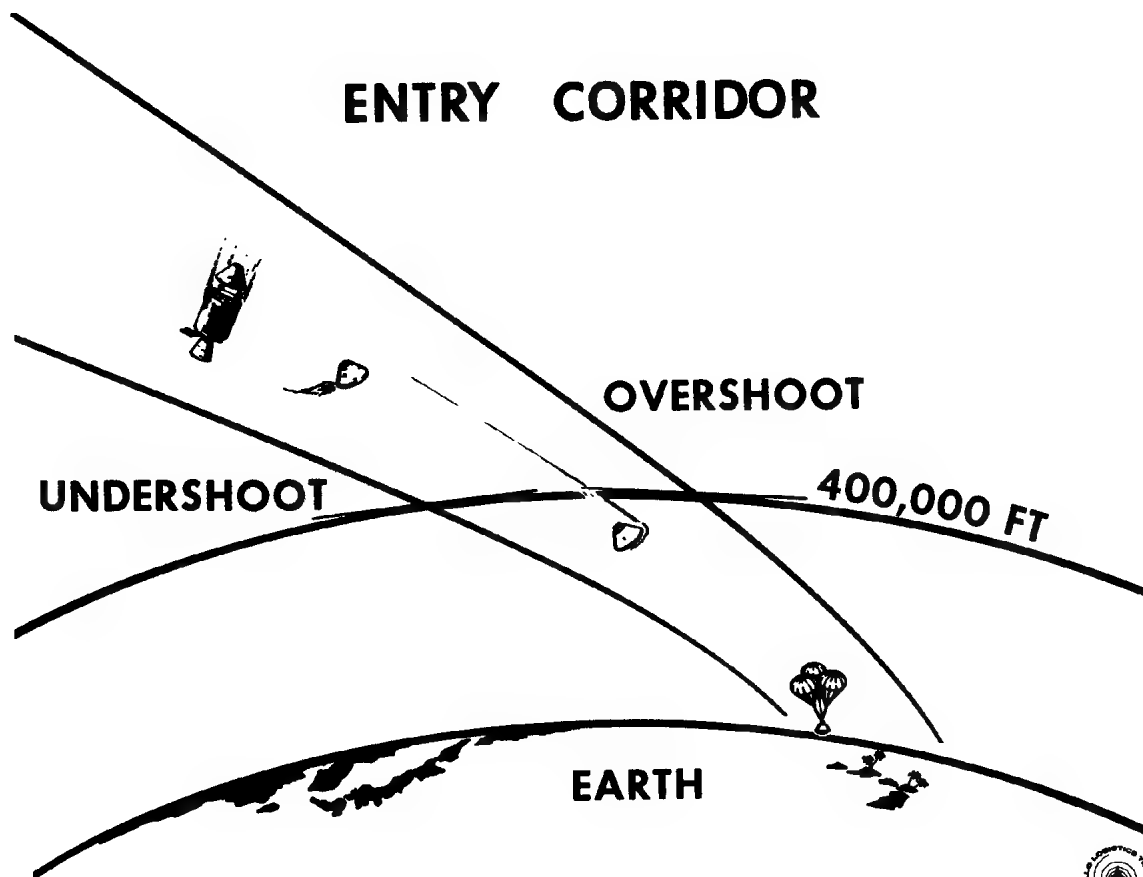


# TRANSEARTH & ENTRY





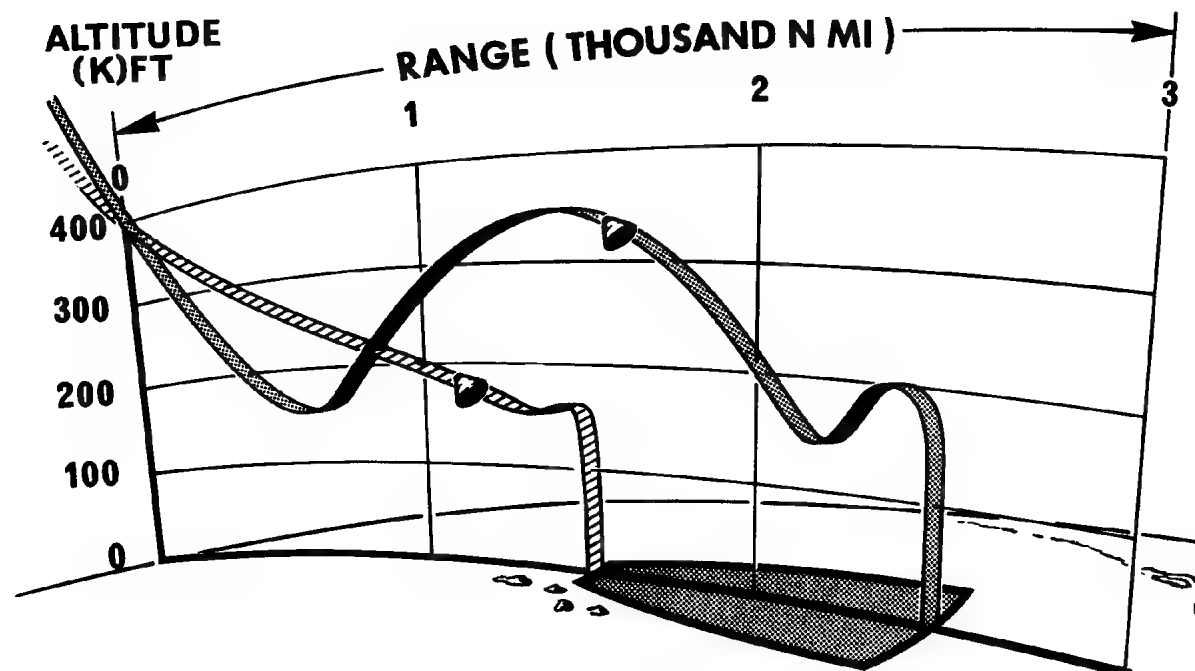
# ENTRY CORRIDOR



FAM-1017A



# TYPICAL RE-ENTRY RANGES



## RECOVERY

HEAT SHIELD  
JETTISONED  
BY 24,000 FEET

AFTER  
TIME DELAY  
DROGUE CHUTES  
DEPLOYED-REEFED

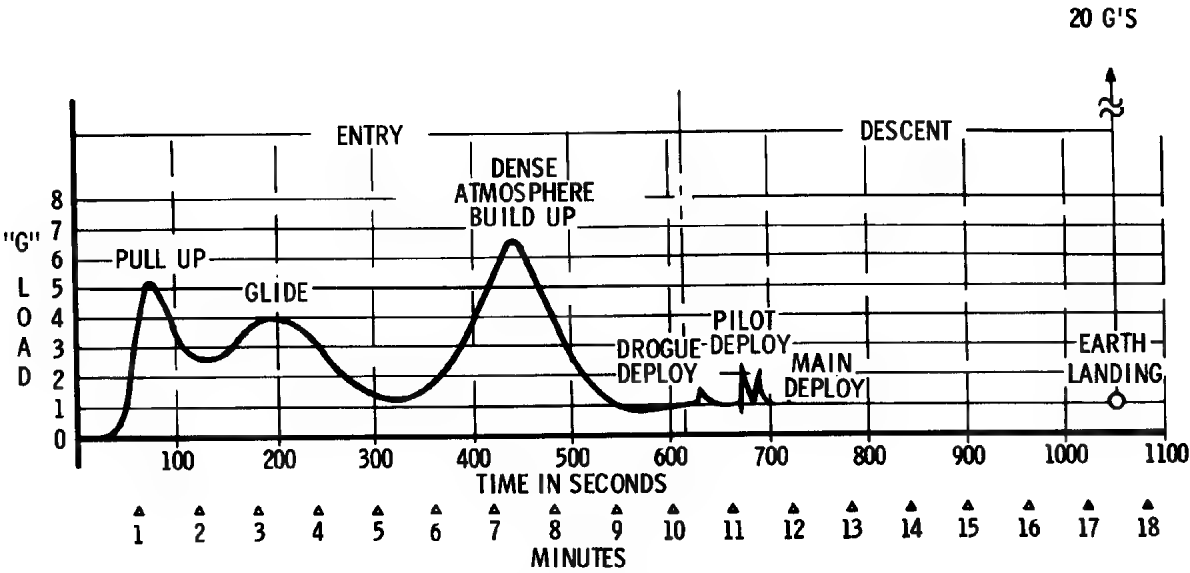
DROGUE CHUTES RELEASED  
AND MAIN CHUTES DEPLOYED  
REEFED BY 10,000 FT

MAIN CHUTES FULLY  
OPENED AFTER BEING  
REEFED

MAIN CHUTES RELEASED AFTER SPLASHDOWN

# "G" FORCES, LUNAR MISSION, BLOCK II

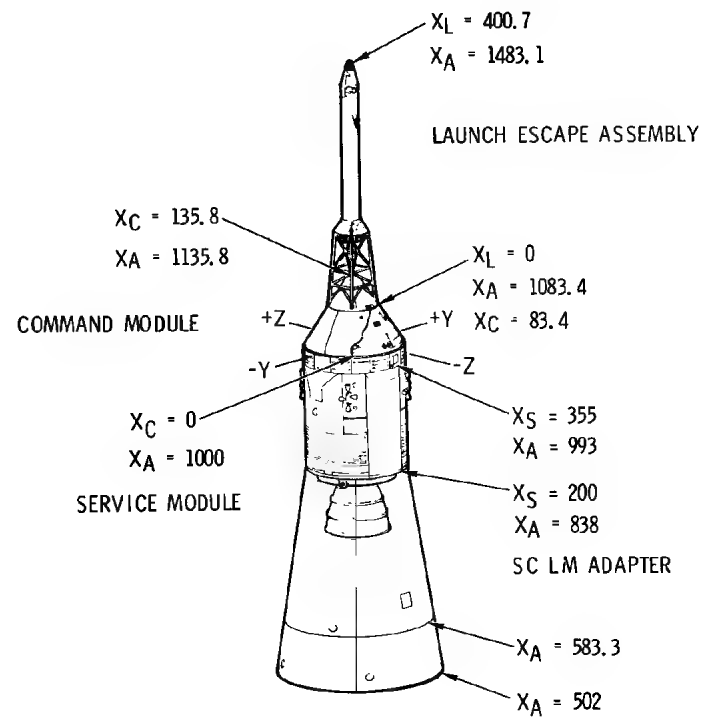
ASTRONAUT SENSED




REF DESIGN REFERENCE MISSION, LED-540-12 dtd OCT 64

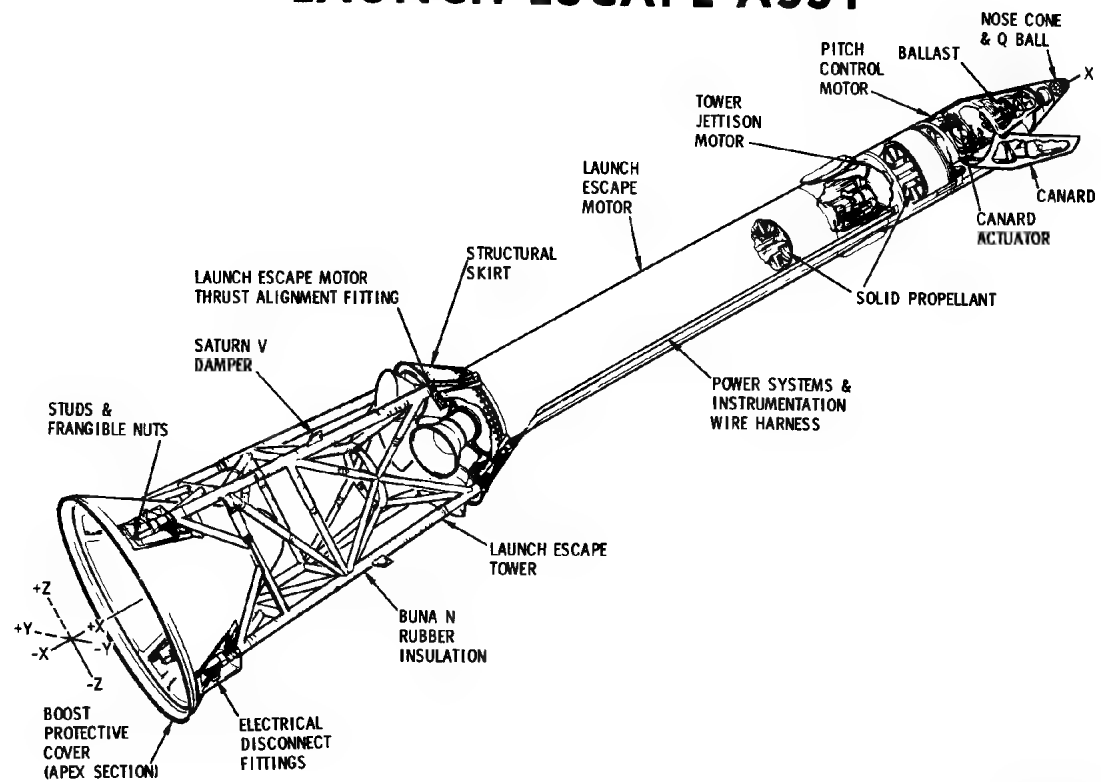
# STRUCTURES

## APOLLO INTEGRATED STATION & CSM AXIS



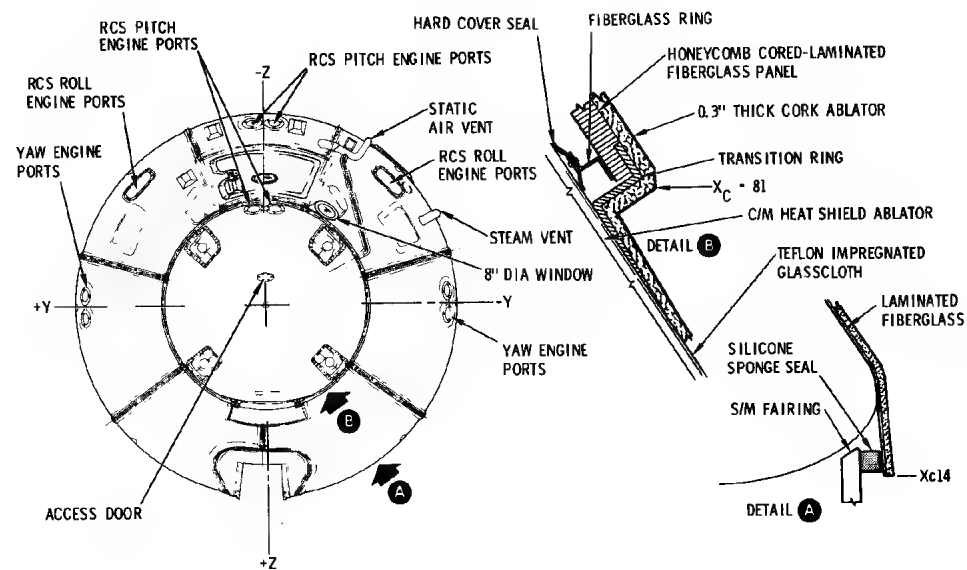
ST-107A 

# LAUNCH ESCAPE ASSY



# BOOST PROTECTIVE COVER

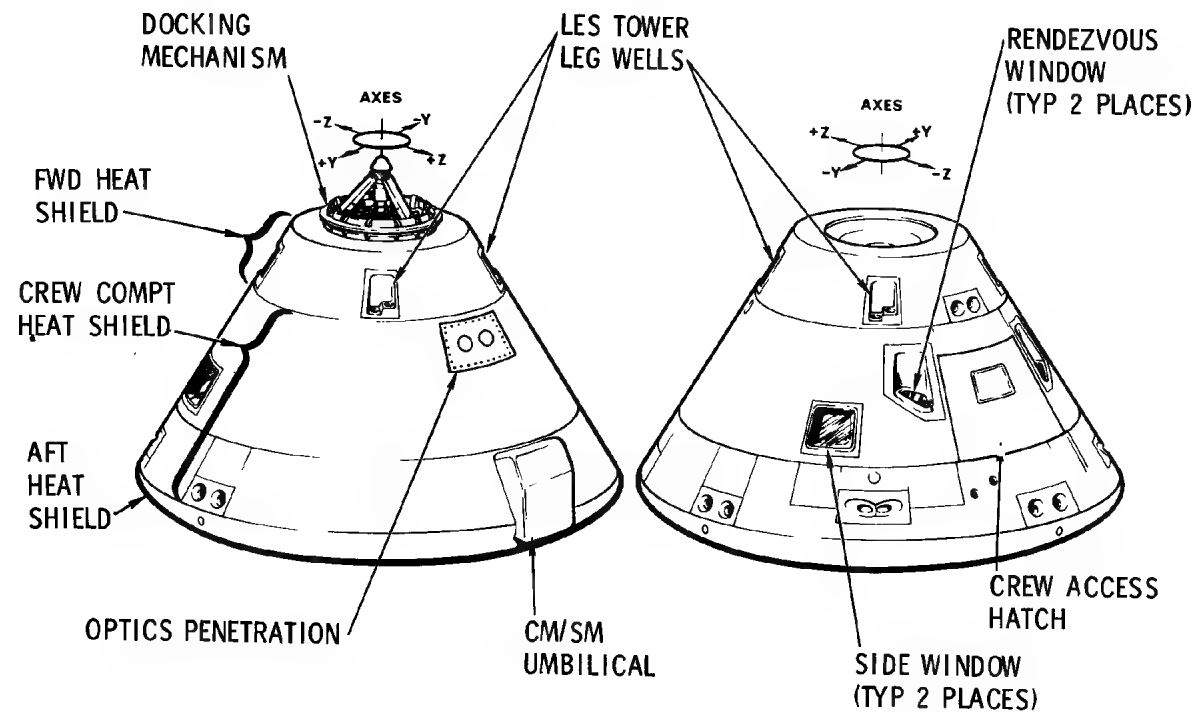
BLOCK II CSM





# COMMAND MODULE EXTERIOR

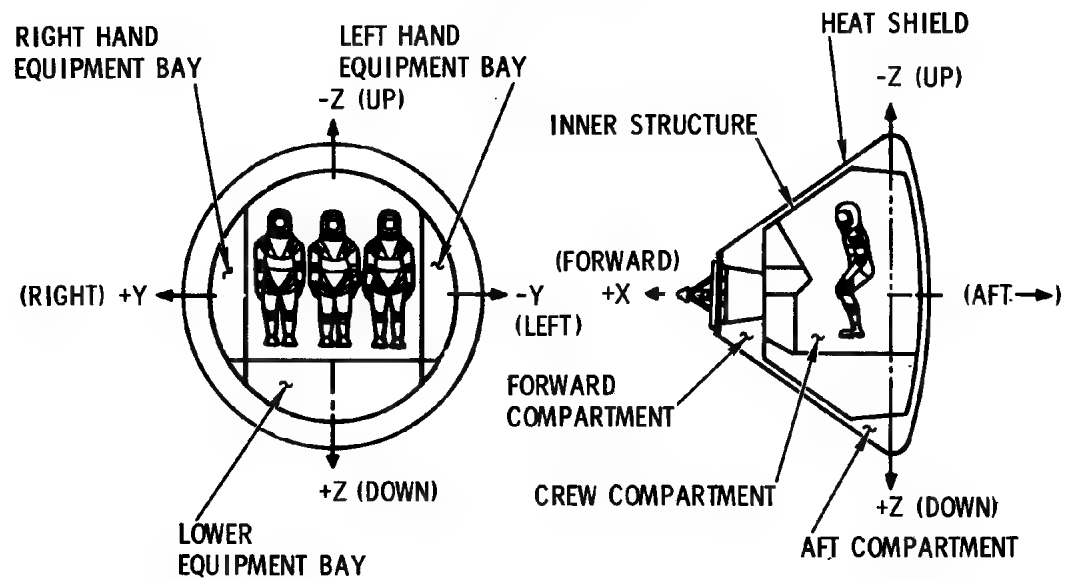
## BLOCK II



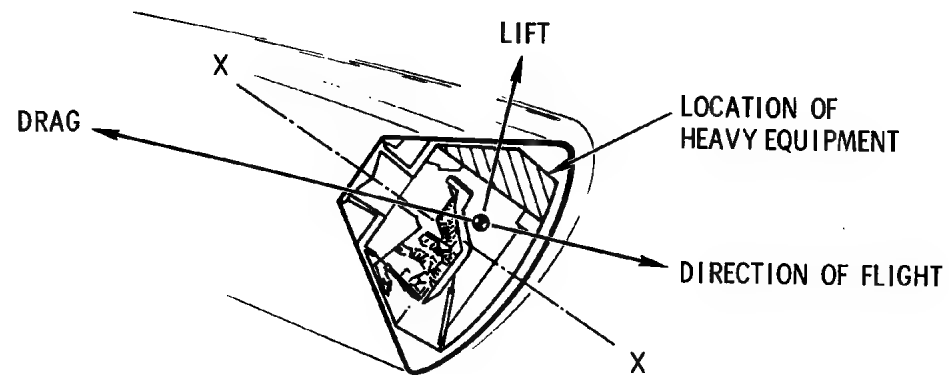
ST-260B




# COMMAND MODULE COMPARTMENT ORIENTATION BLOCK II



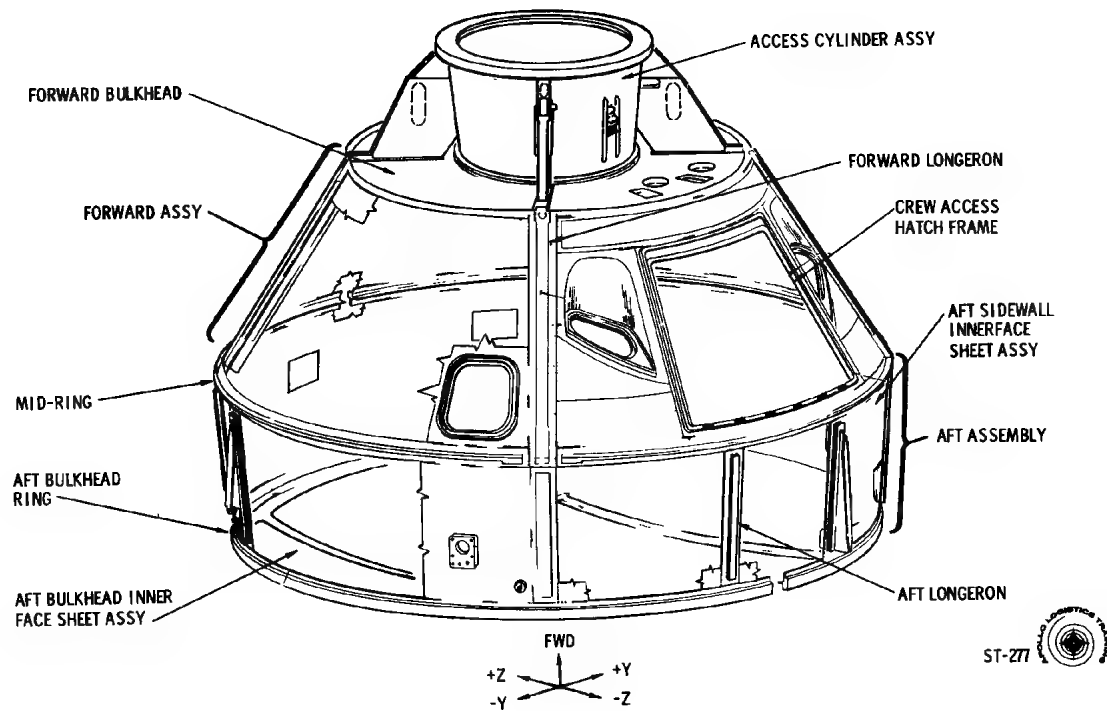
# COMMAND MODULE AERODYNAMICS



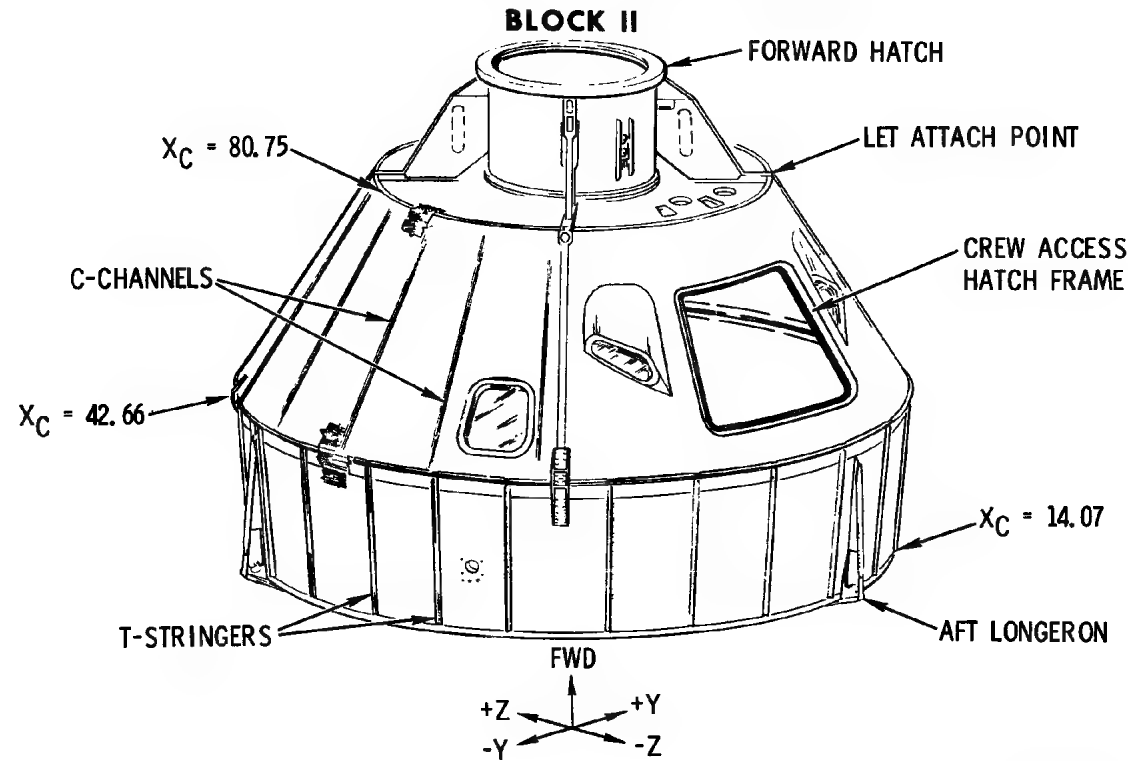
FAM-1511 


# INNER STRUCTURE

INNER SHELL (BLOCK II)



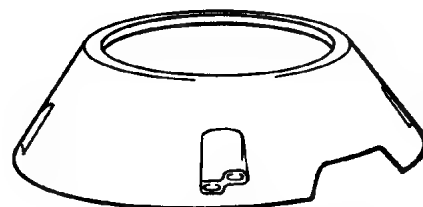
## CM INNER STRUCTURE



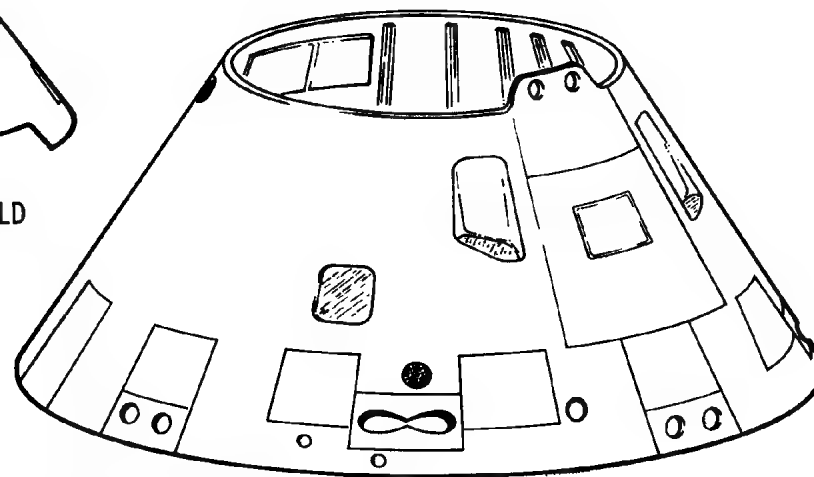
ST-278A 

# COMMAND MODULE HEAT SHIELDS

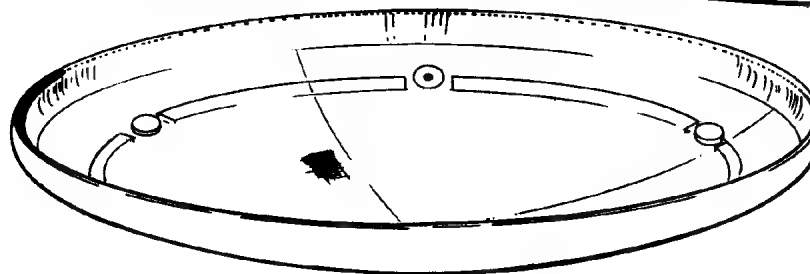
BLOCK II



FORWARD HEAT SHIELD



CREW COMPARTMENT  
HEAT SHIELD

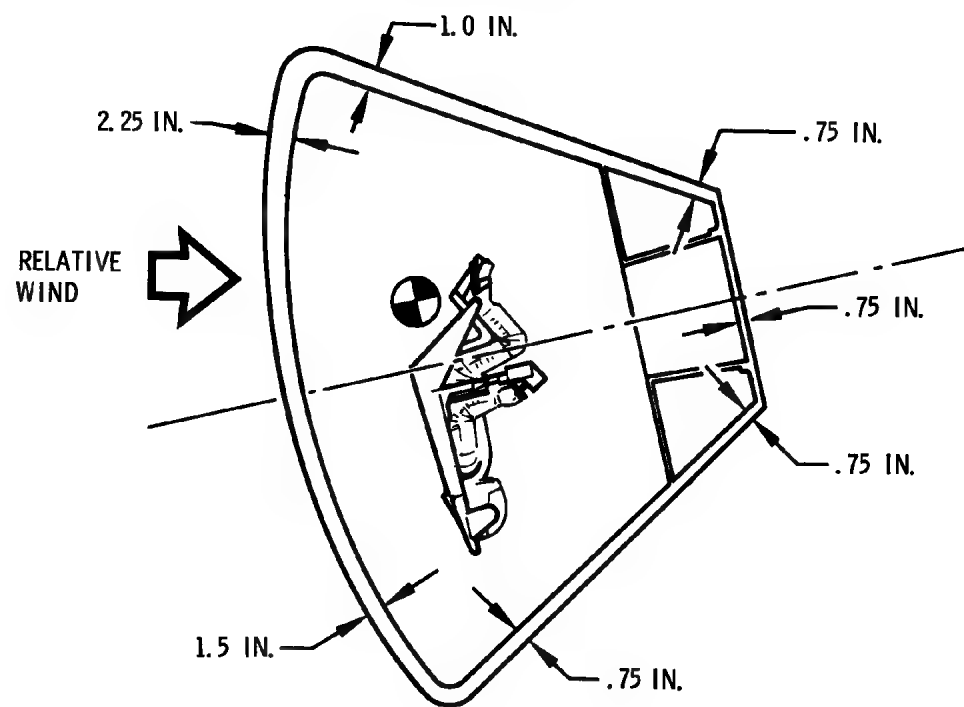



AFT HEAT SHIELD

FAM-1504A

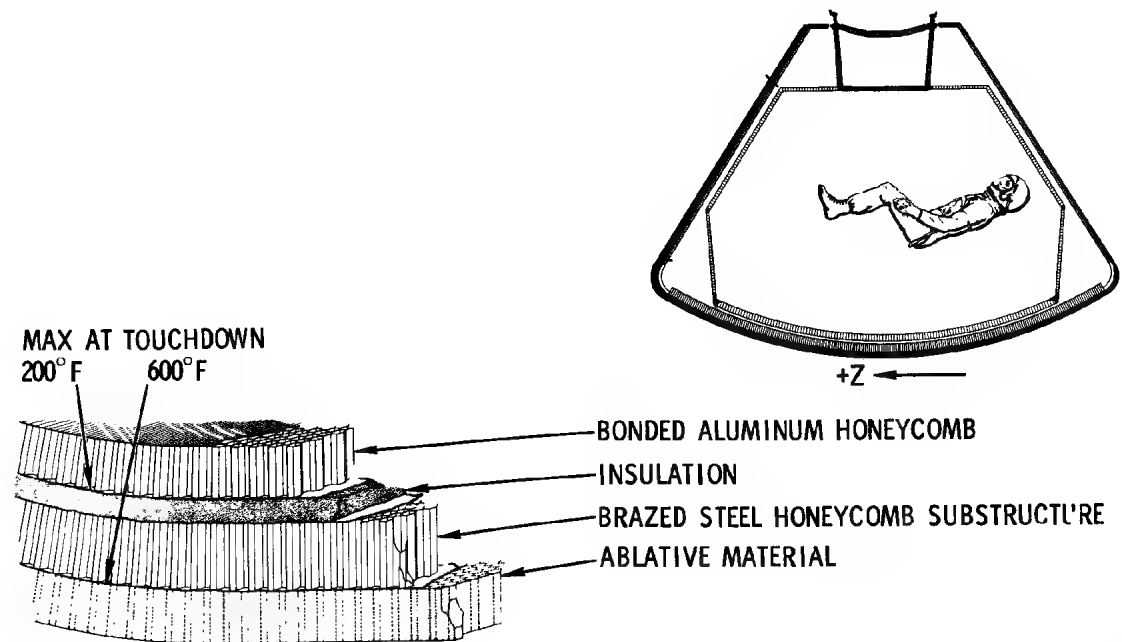


# COMMAND MODULE ABLATIVE MATERIAL THICKNESS BLOCK II



ST-530 

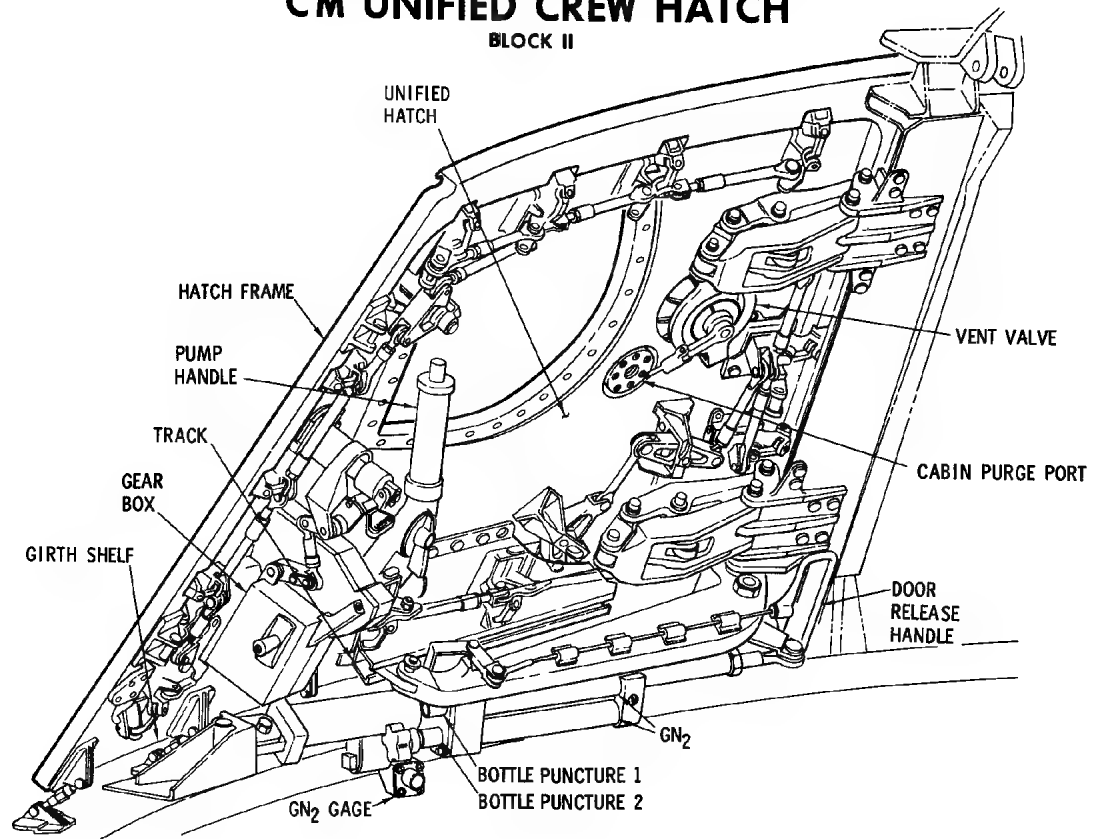
# COMMAND MODULE SKIN CONFIGURATION





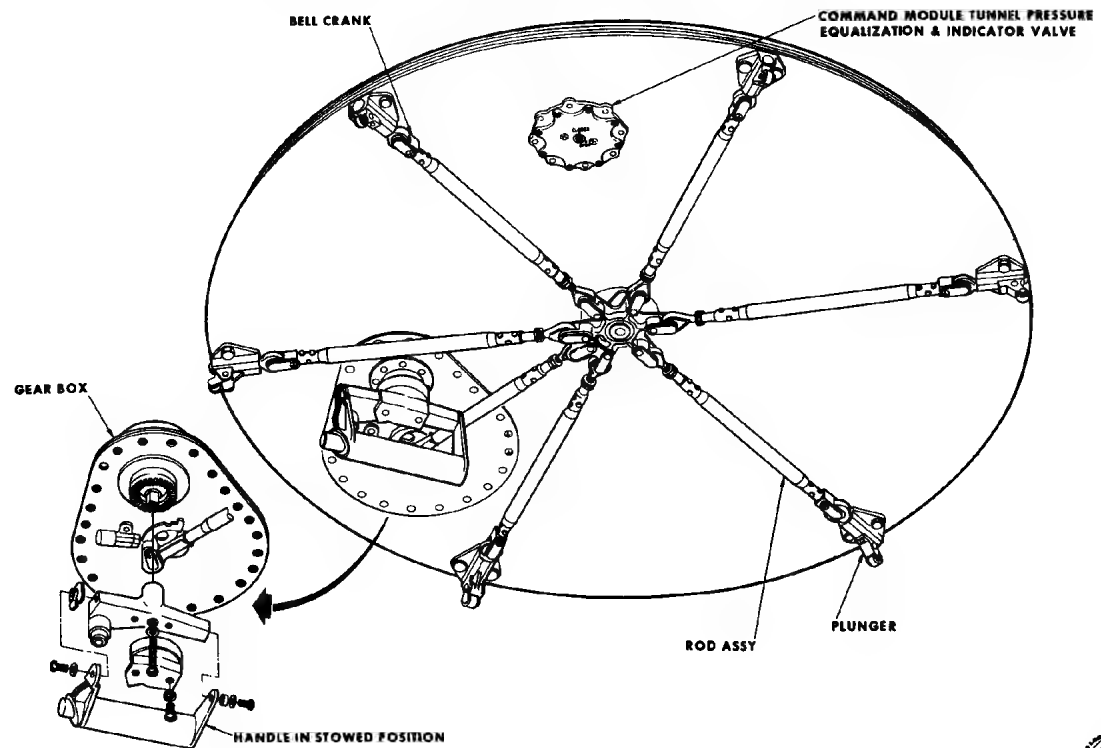
# CM UNIFIED CREW HATCH

BLOCK II

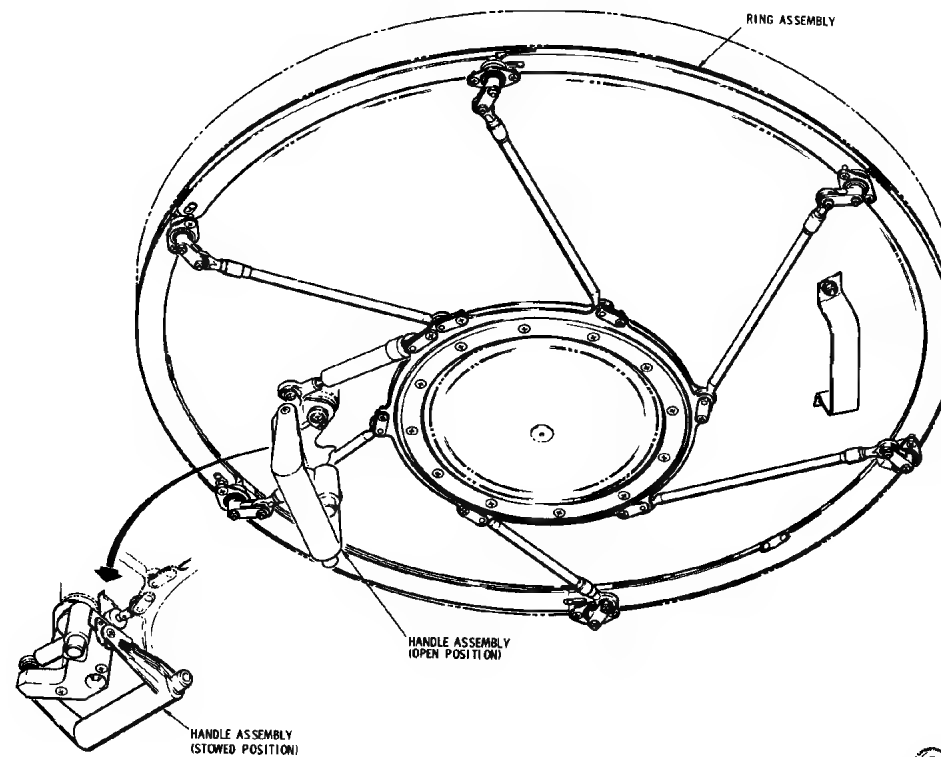


# FORWARD PRESSURE HATCH

## BLOCK II

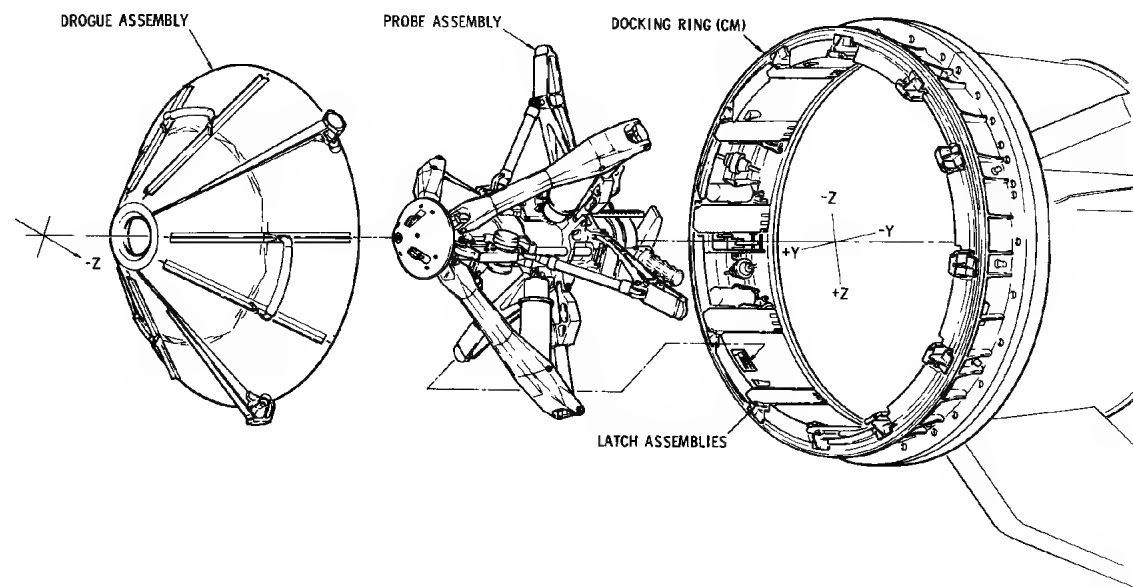


# ABLATIVE HATCH

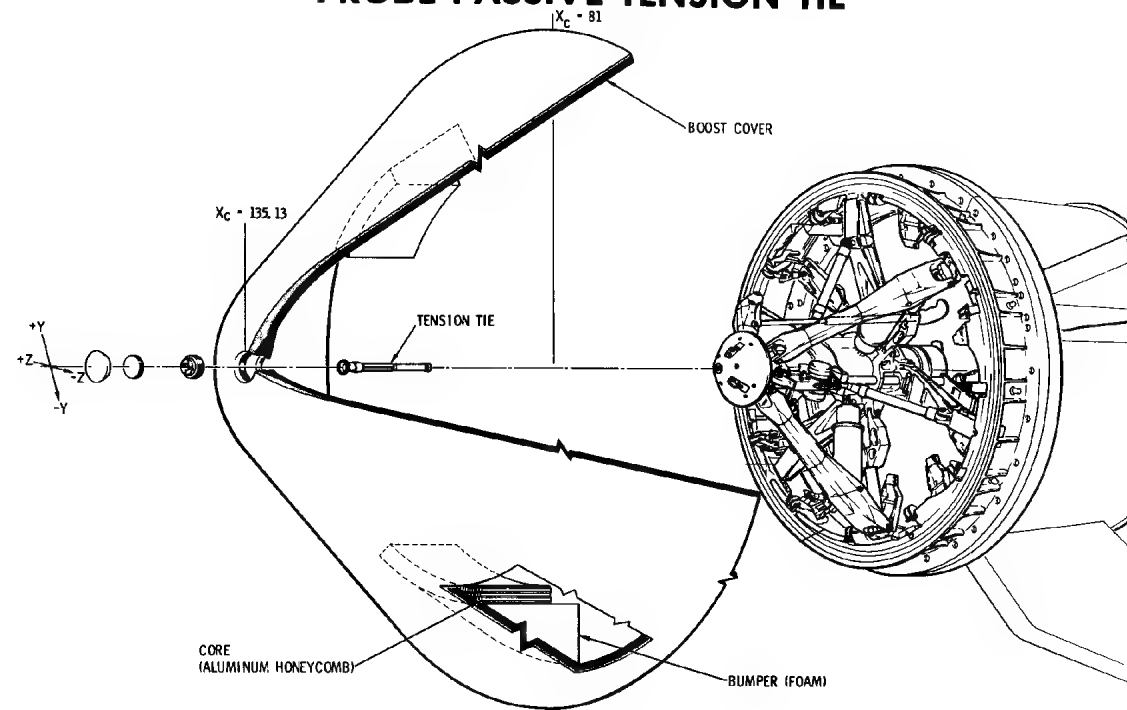


ST-501

# PROBE INSTALLATION-DOCKING SYSTEM



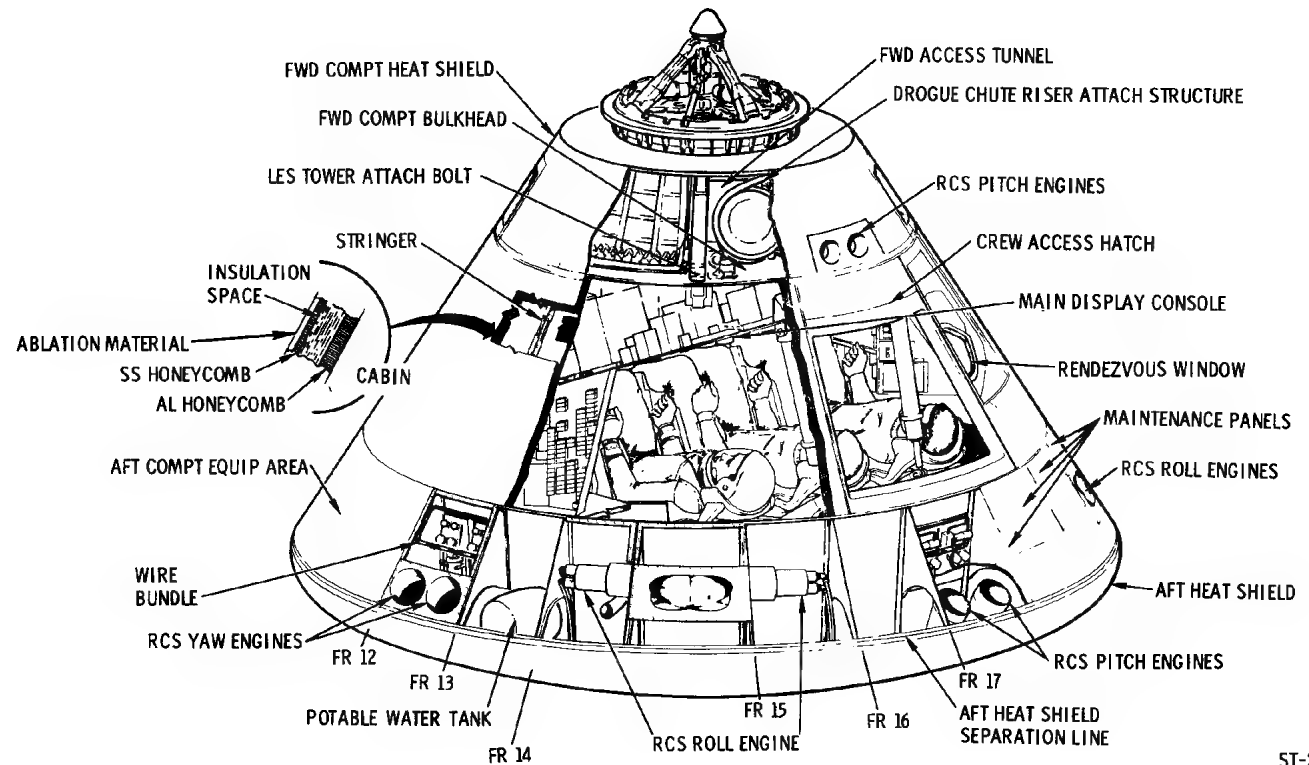
## PROBE PASSIVE TENSION TIE



DKG-013A

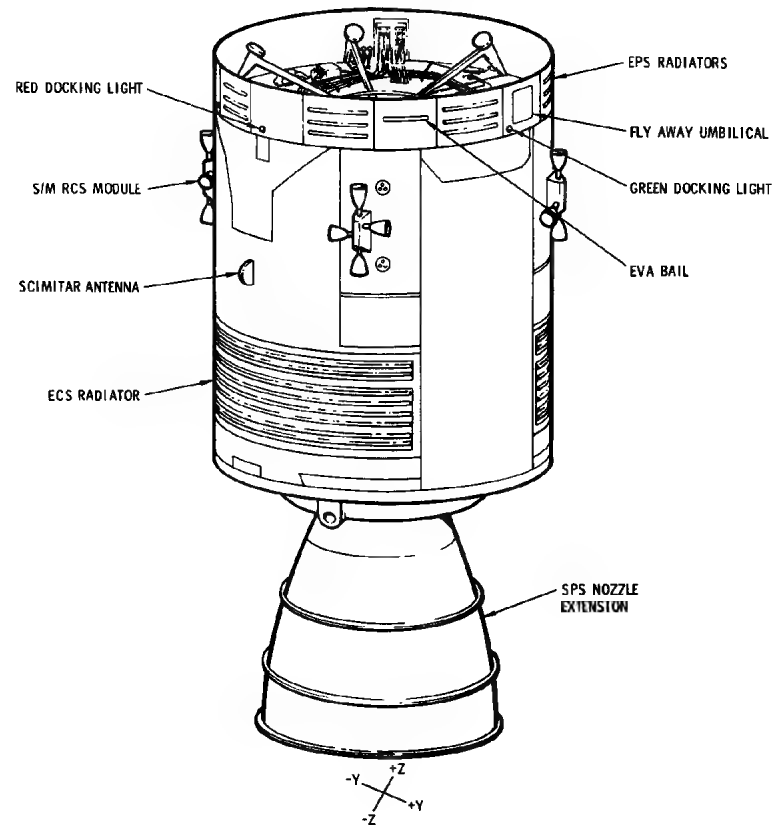


# GENERAL ARRANGEMENT COMMAND MODULE (BLOCK II)



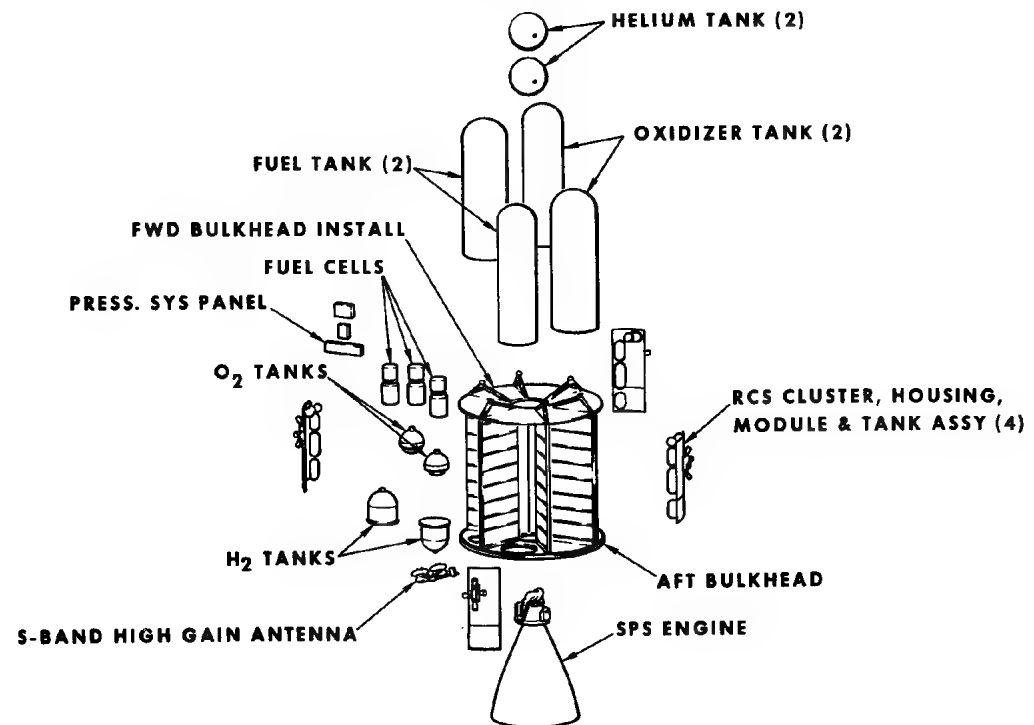
# SERVICE MODULE

BLOCK II



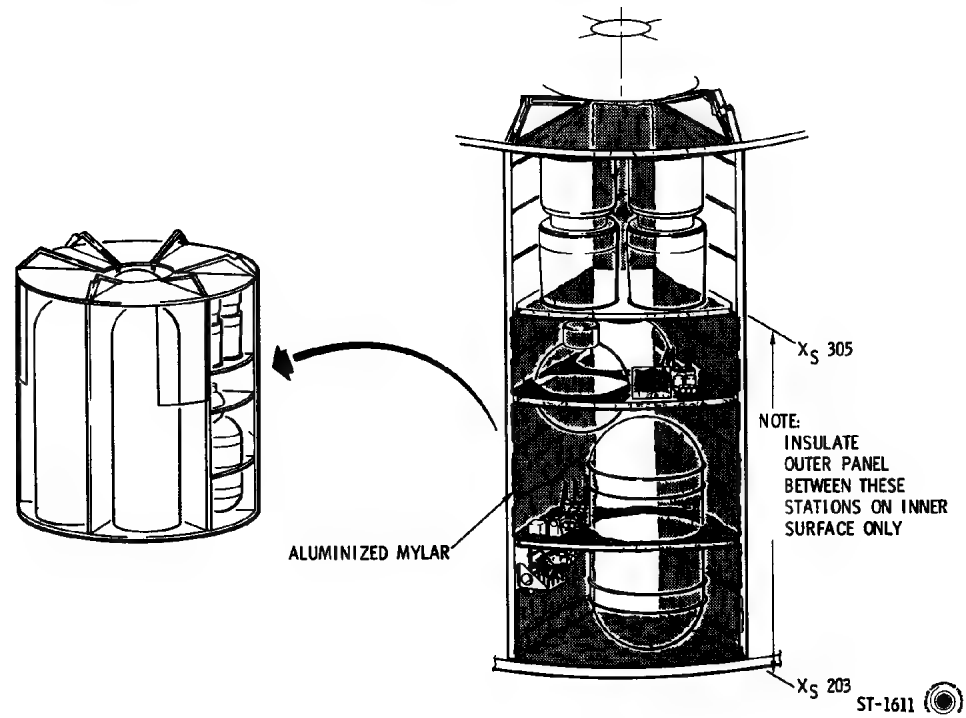
# APOLLO SM SYSTEMS EQUIPMENT

## BLOCK II

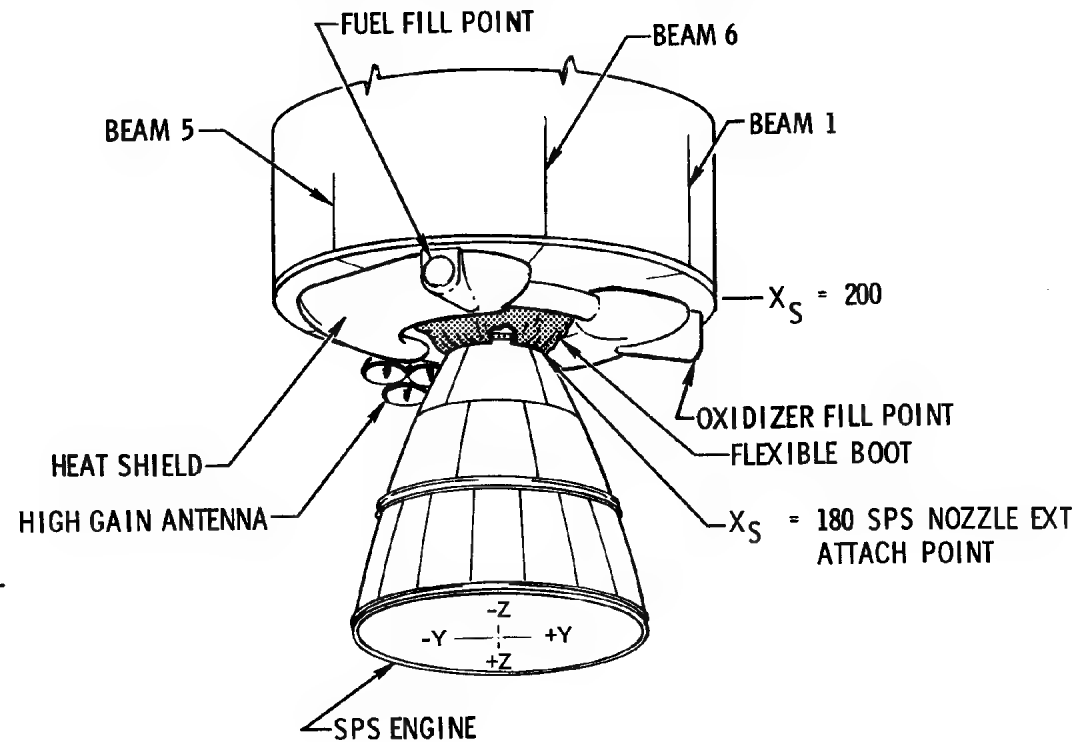




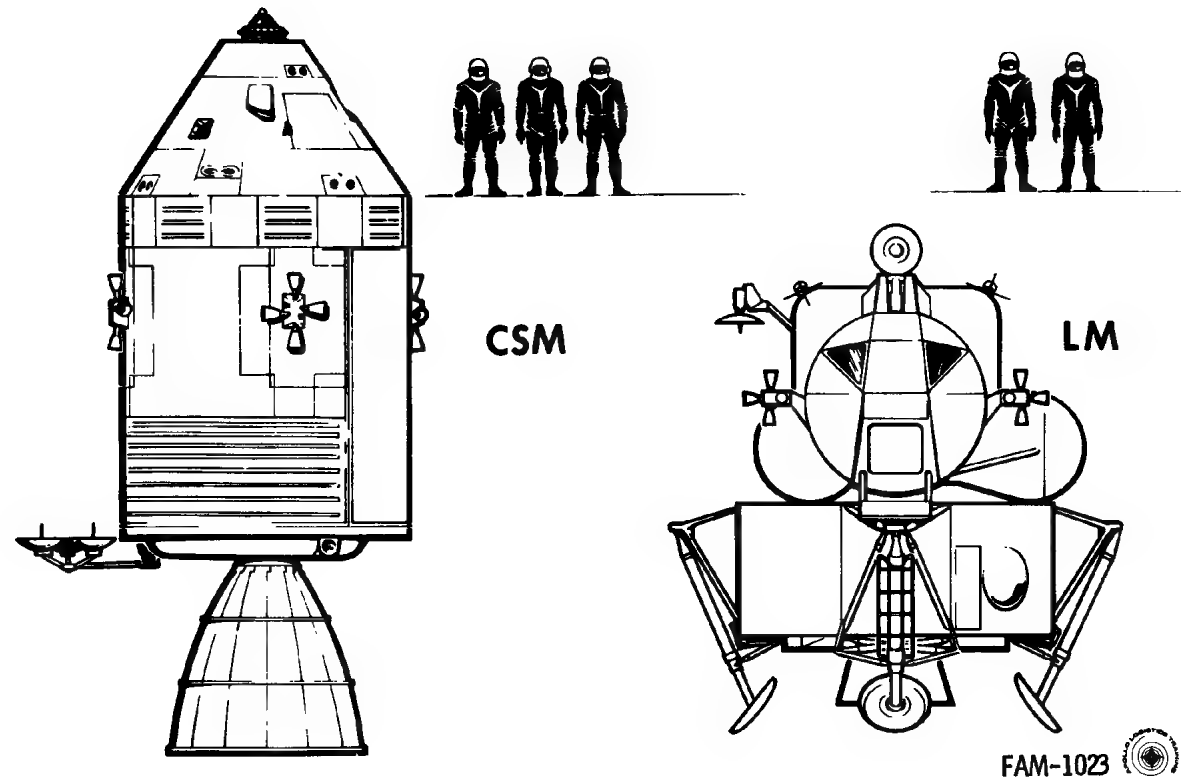
## SM INSULATION TYPICAL FOR SECTOR IV



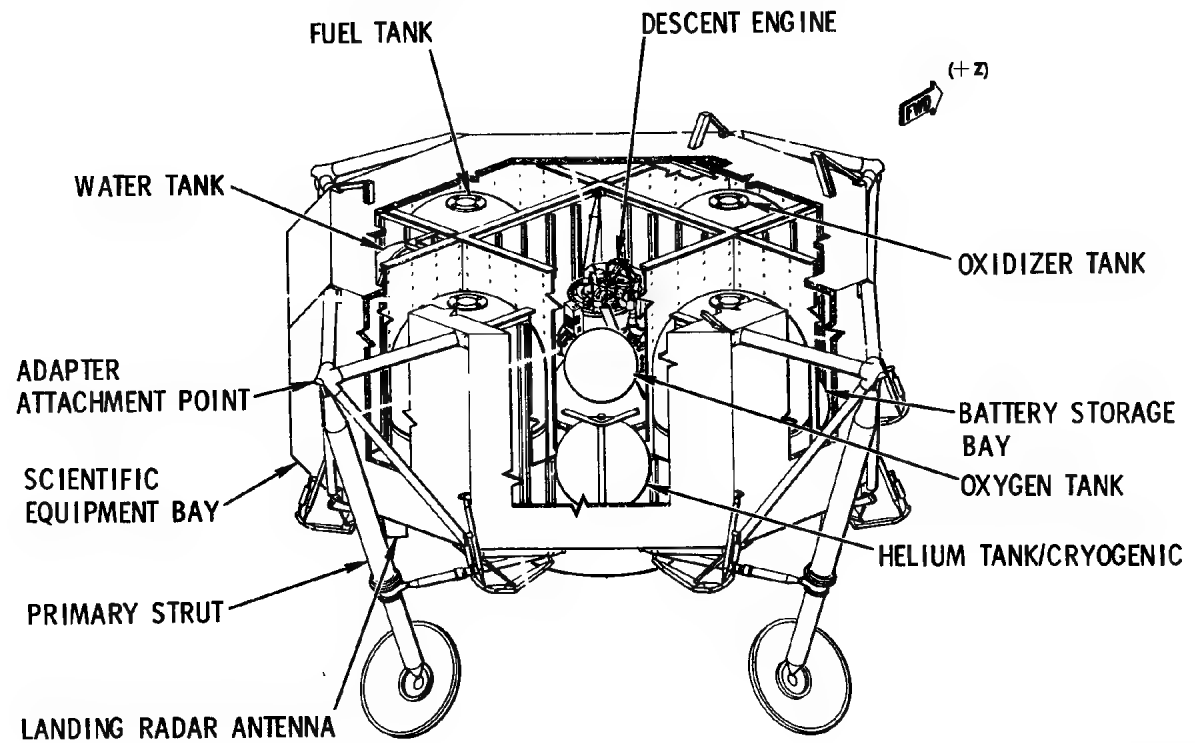
## S/M SPS NOZZLE AND HEAT SHIELD




## CSM & LM COMPARISON



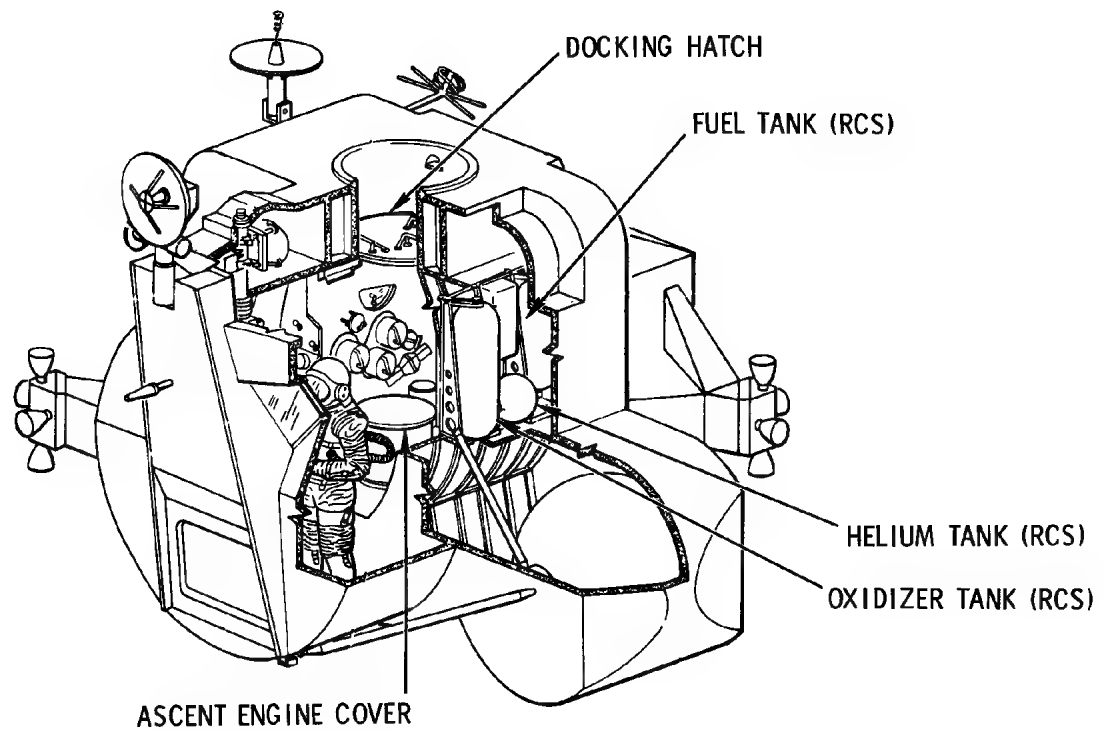
## LM DESCENT STAGE



FAM-1512 A 

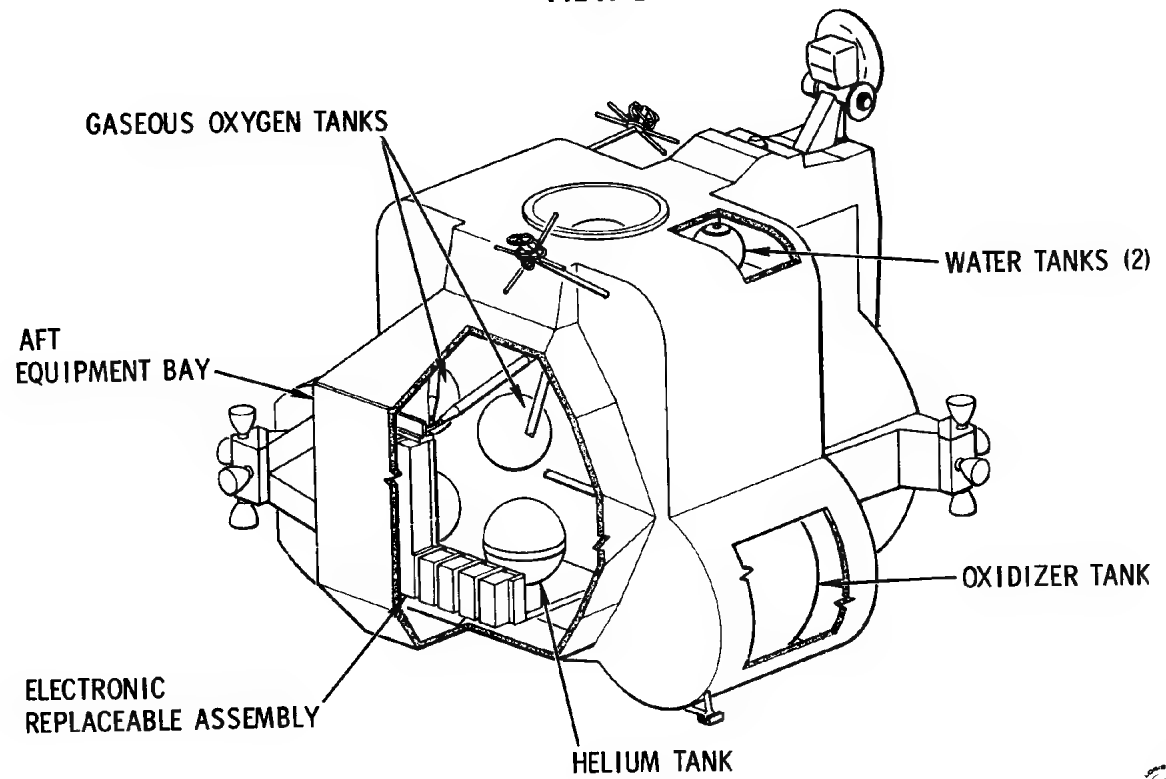
# LM ASCENT STAGE

VIEW A



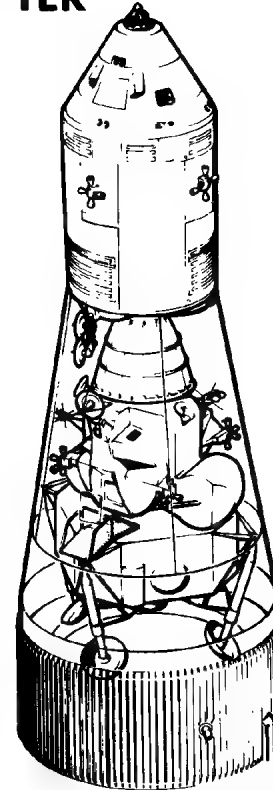
# LM ASCENT STAGE


VIEW B



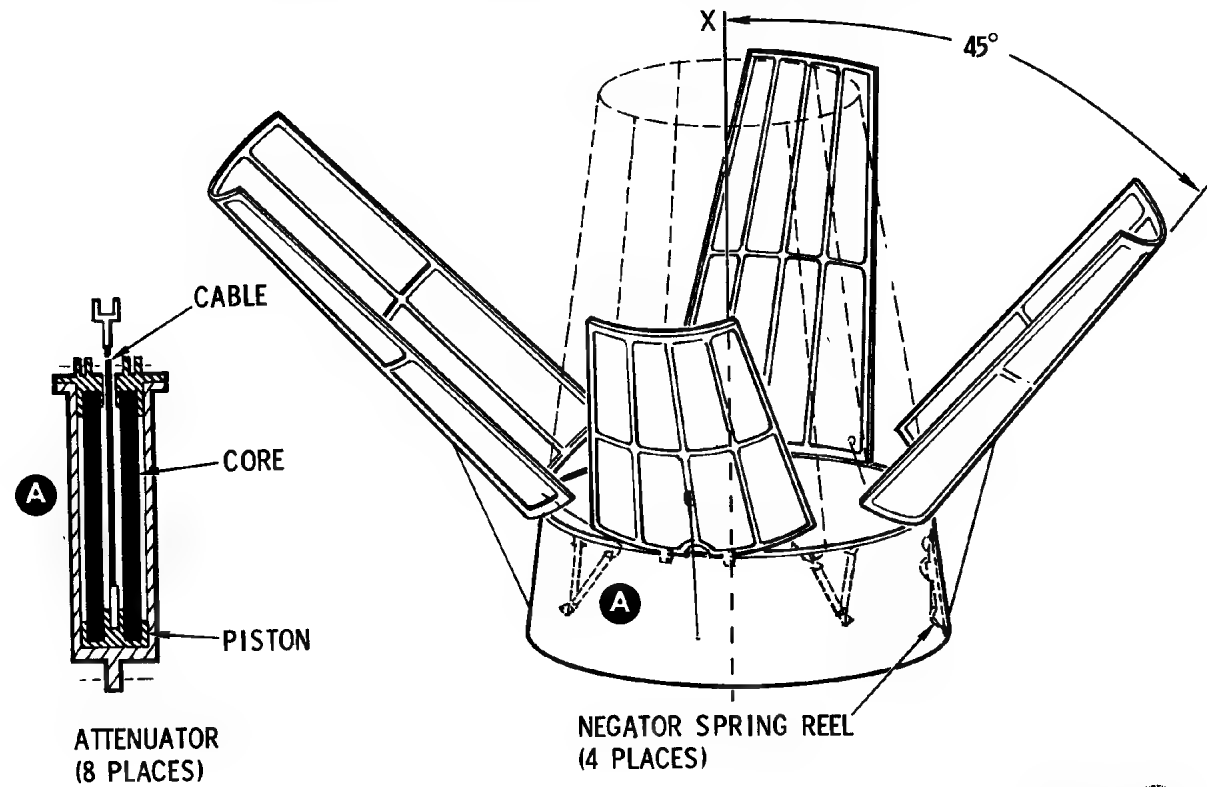
## SPACECRAFT/LM ADAPTER

PANEL SEPARATION BY  
EXPLOSIVE CHARGES  
(MDF)



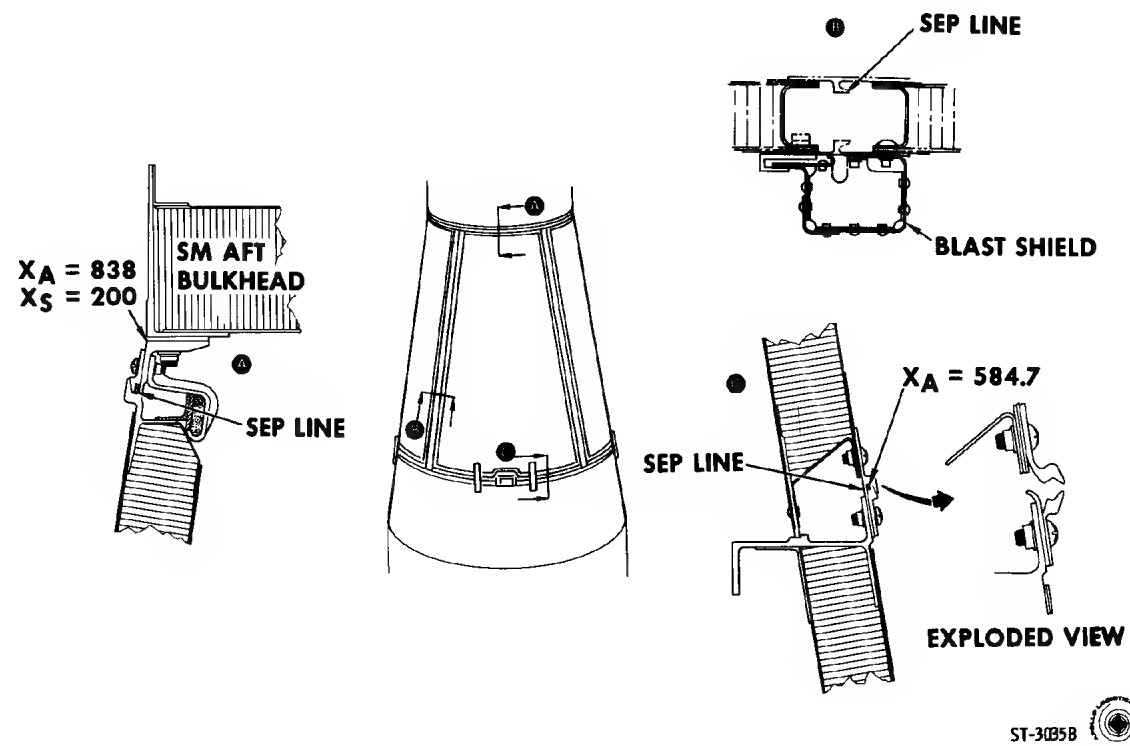
FAM-1508D 

## SLA PANEL DEPLOYMENT



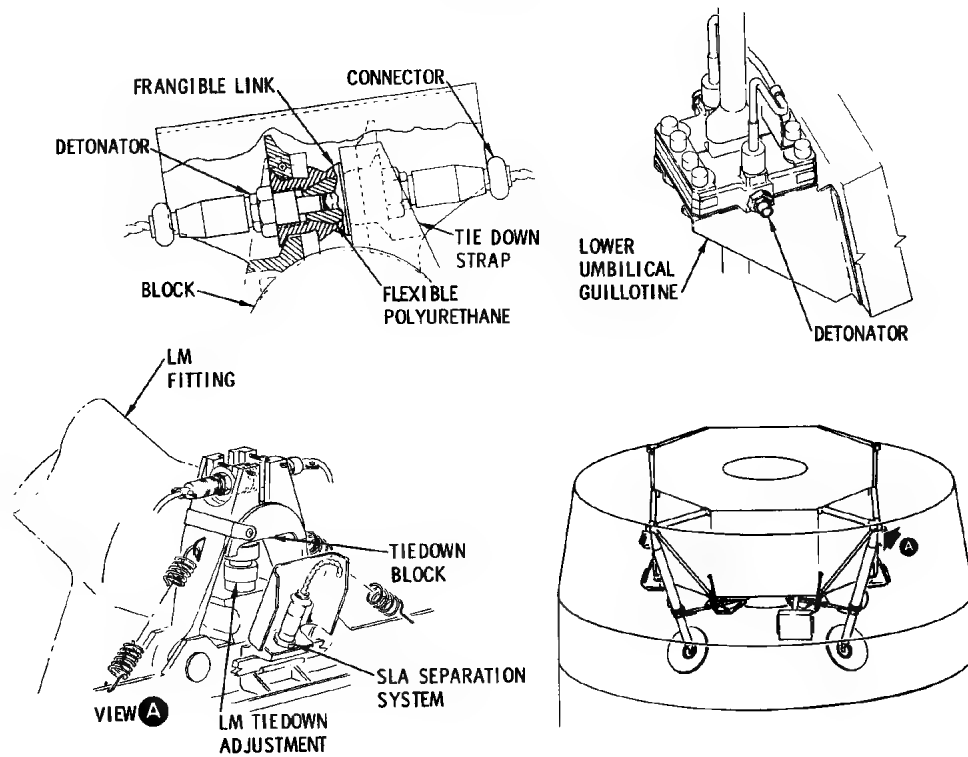


## ADAPTER PANEL SEPARATION LINE



# LM SEPARATION SYSTEM

## BLOCK II

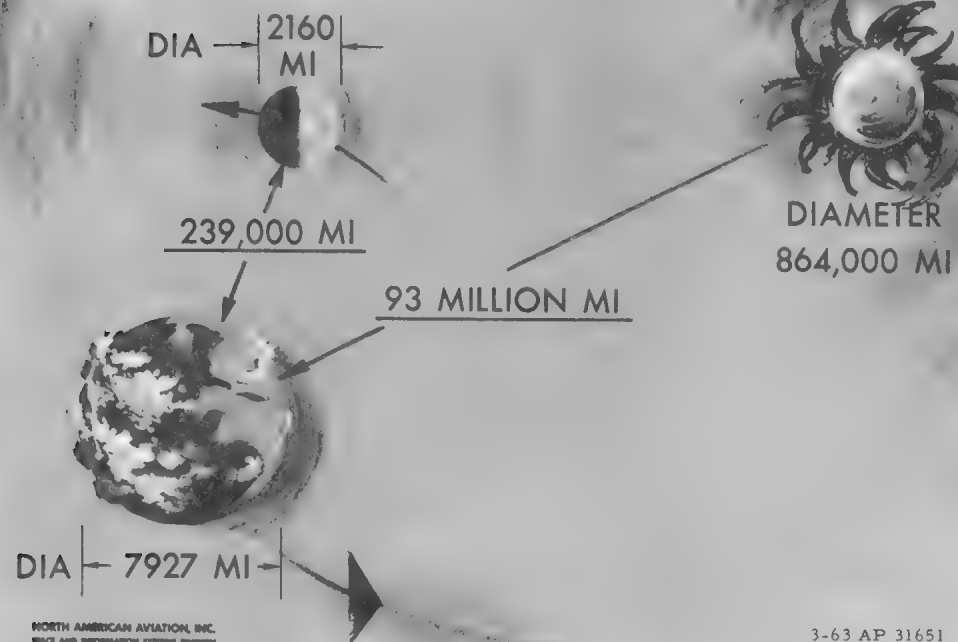


# GUIDANCE & CONTROL

3

FAM-3505 

## BASIC CONSIDERATIONS



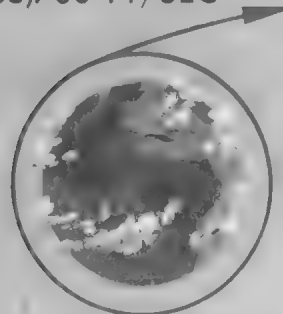
NORTH AMERICAN AVIATION, INC.  
SPACE AND INFORMATION SYSTEMS DIVISION

3-63 AP 31651

## VELOCITY REQUIREMENTS

### ESCAPE VELOCITY

36,700 FT/SEC

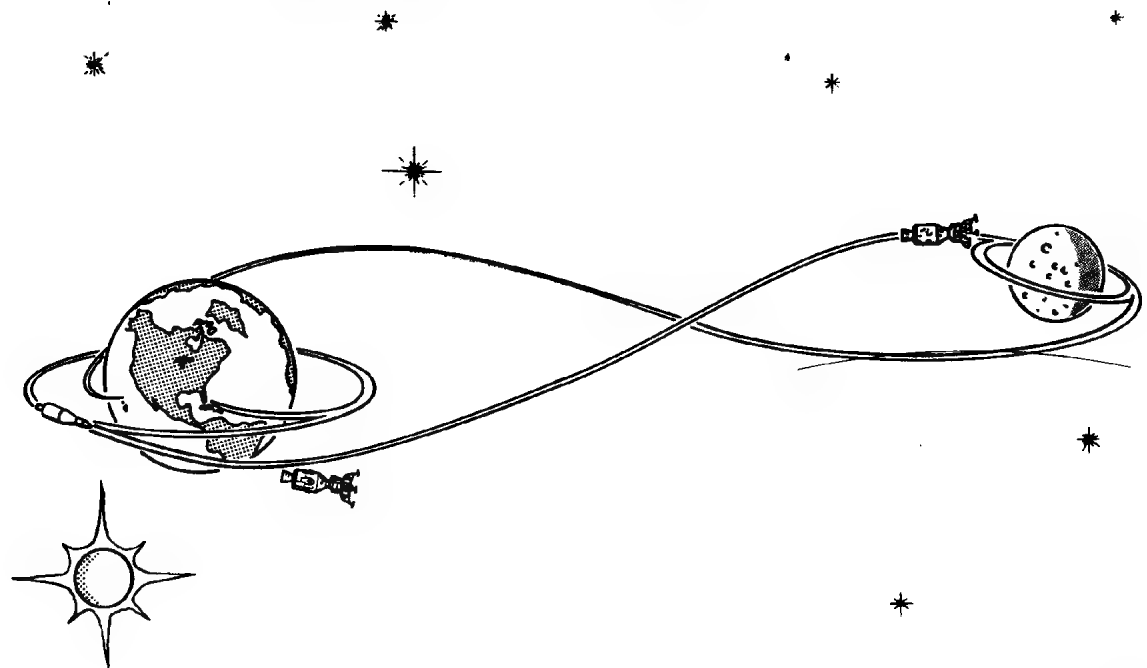


8,400 FT/SEC

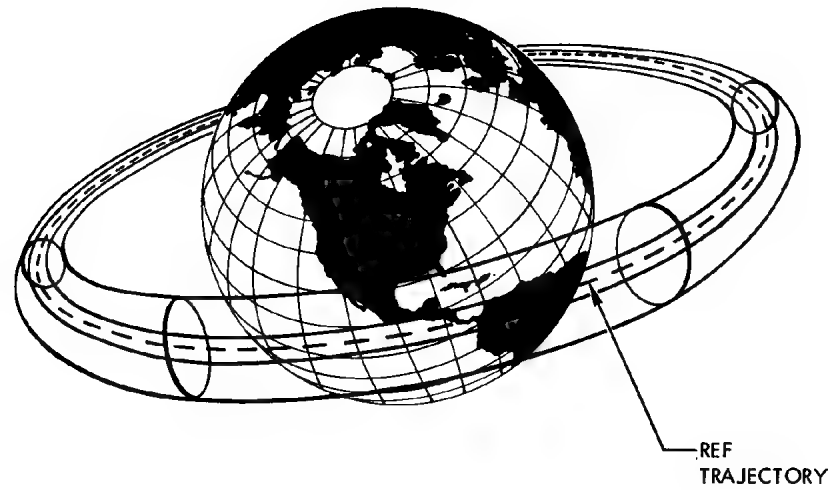
25,000 FT/SEC - ORBIT - 5280 FT/SEC

6 - RELATIVE GRAVITY - 1

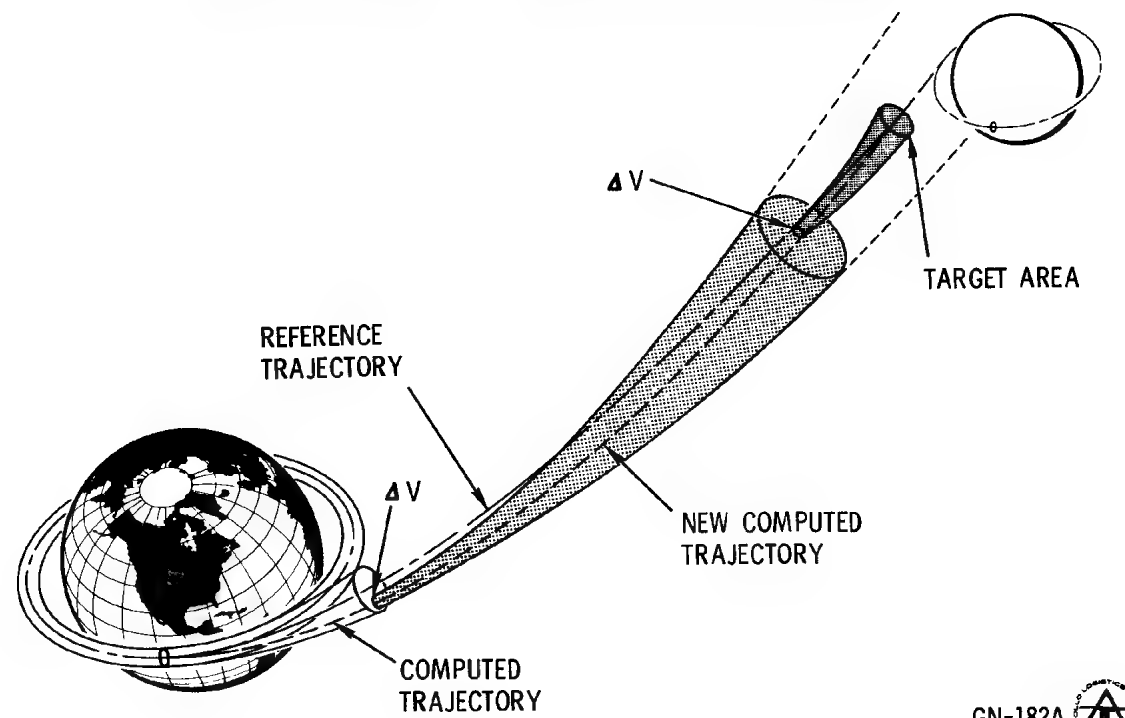
# GUIDANCE & NAVIGATION REFERENCE TRAJECTORIES



# EARTH ORBIT POSITION & TRAJECTORY DETERMINATION



## MIDCOURSE POSITION & TRAJECTORY DETERMINATION





# GUIDANCE & CONTROL FUNCTIONS

## GNCS

- POSITION
- TRAJECTORY
- VELOCITY
- ATTITUDE

## SCS

- RATE CONTROL
- ATTITUDE CONTROL
- DISPLAY
- MANUAL CONTROLS

## RCS

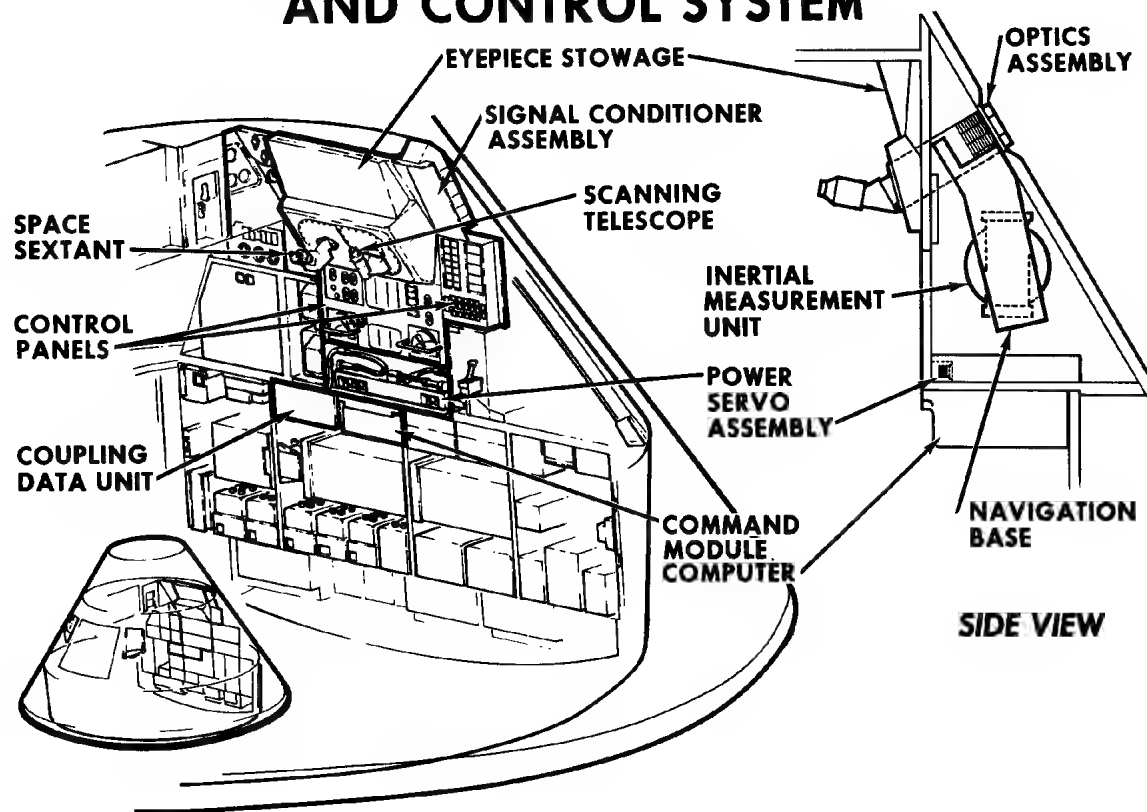
- ROTATION  
ROLL  
PITCH  
YAW
- TRANSLATION  
X, Y, Z  
ACCELERATIONS

## SPS

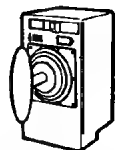
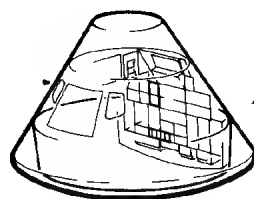
- MID-COURSE  
CORRECTIONS
- PLANE  
CHANGES
- LUNAR ORBIT  
INSERTION
- TRANS-EARTH  
INJECTION

# GUIDANCE, NAVIGATION, AND CONTROL SYSTEM

S86SD10793B



## STABILIZATION AND CONTROL SYSTEM

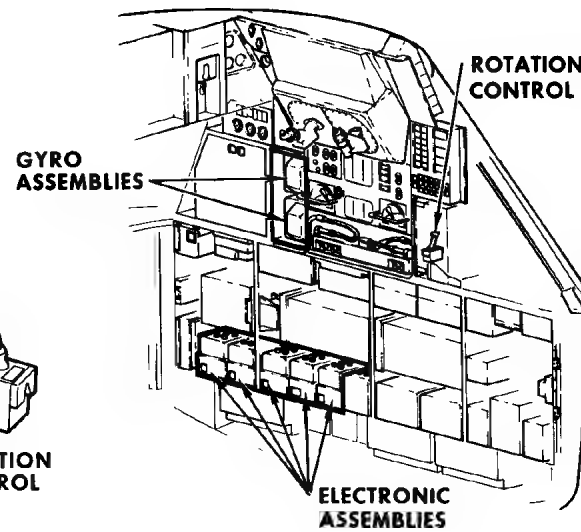


TRANSLATION  
CONTROL

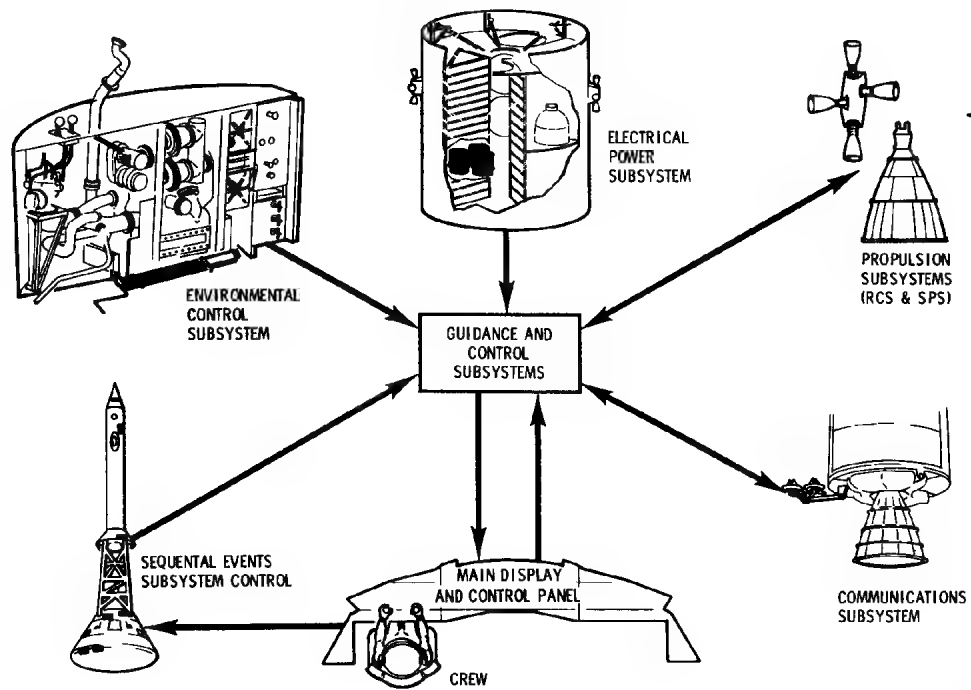


ROTATION  
CONTROL

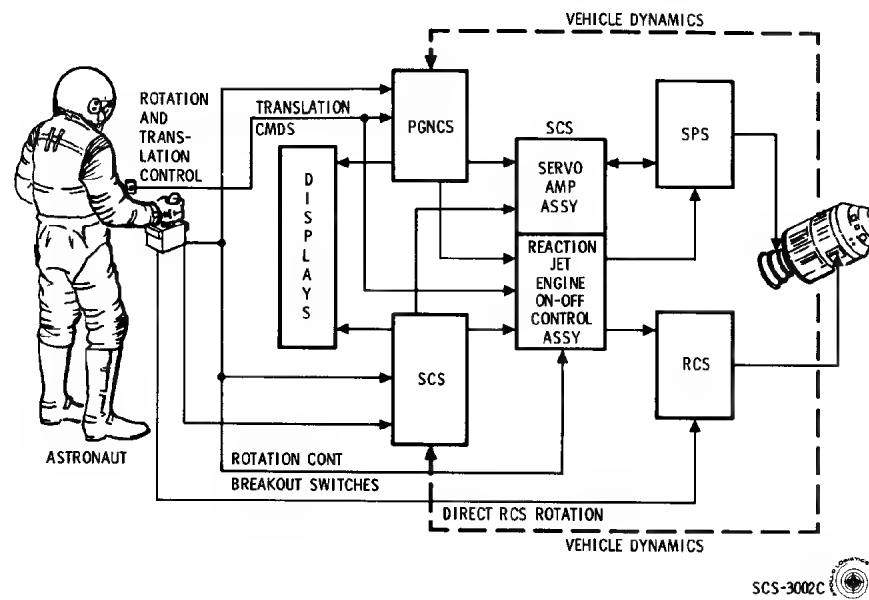
MANUAL CONTROLS



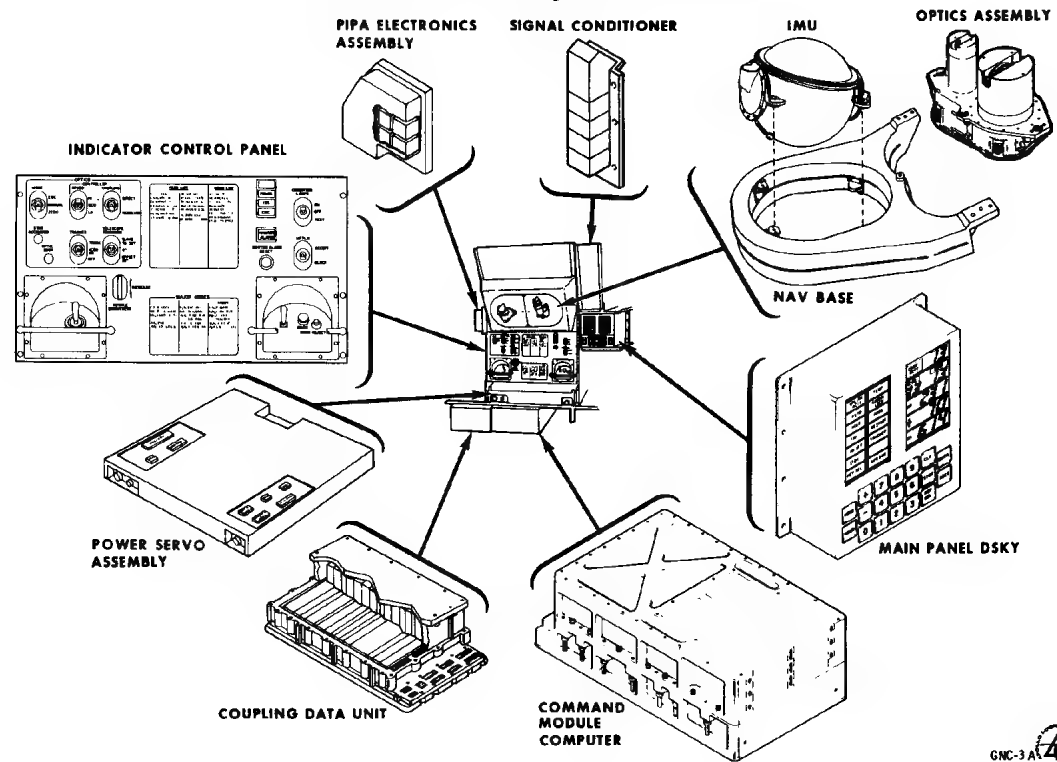
# G&C AND APOLLO SUBSYSTEMS INTERFACE



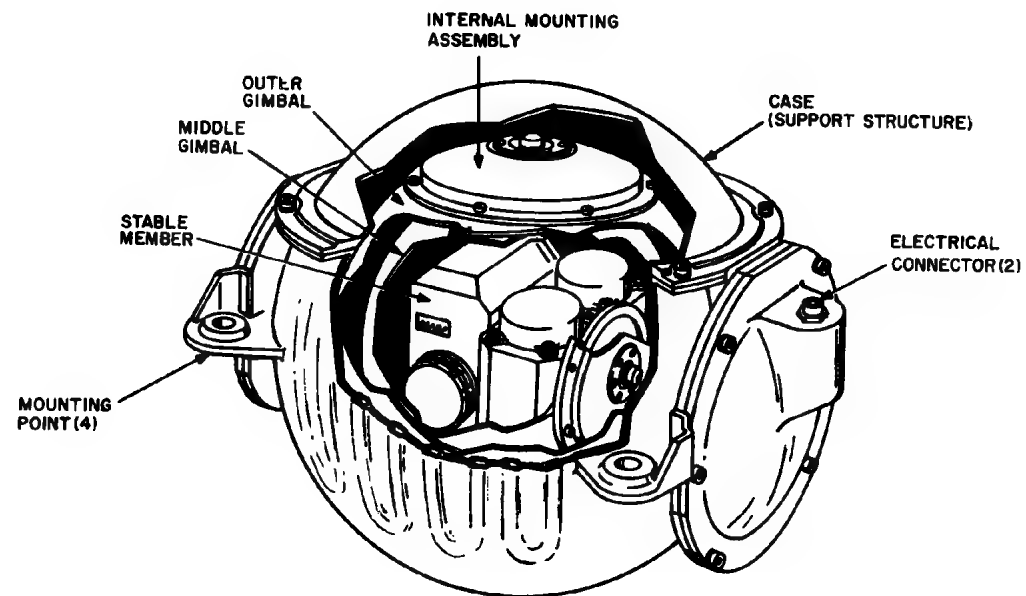
# CSM GUIDANCE & CONTROL



# PGNCS EQUIPMENT



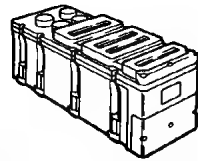
# INERTIAL MEASUREMENT UNIT



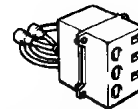
GNC-9 (✦)

# SCS FLIGHT HARDWARE

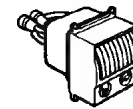
## BLOCK II



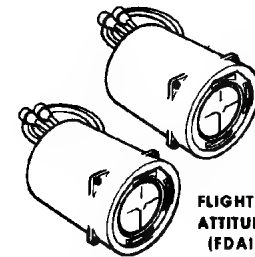
**ELECTRONIC CONTROL ASSEMBLY  
(ECA)**



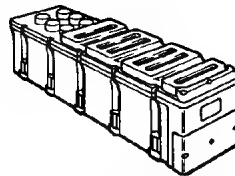
**ATTITUDE SET CONTROL PANEL  
(ASCP)**



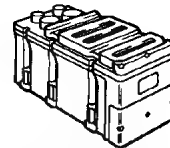
**GIMBAL POSITION/  
FUEL PRESSURE INDICATOR  
(GP/FPI)**



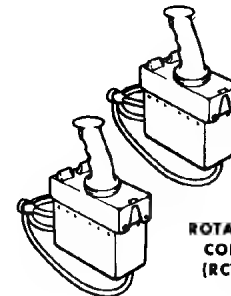
**FLIGHT DIRECTOR  
ATTITUDE INDICATOR  
(FDAI 1, FDAI 2)**



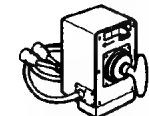
**REACTION JET AND ENGINE  
ON-OFF CONTROL  
(RJ/EC)**



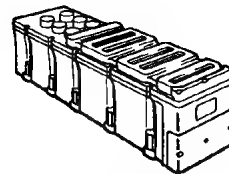
**THRUST VECTOR POSITION  
SERVO AMPLIFIER  
(TVSA)**



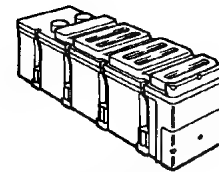
**ROTATION  
CONTROL  
(RC1, RC2)**



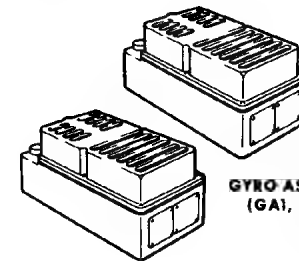
**TRANSLATION CONTROL  
(TC)**




**ELECTRONIC DISPLAY ASSEMBLY  
(EDA)**



**GYRO DISPLAY COUPLER  
(GDC)**

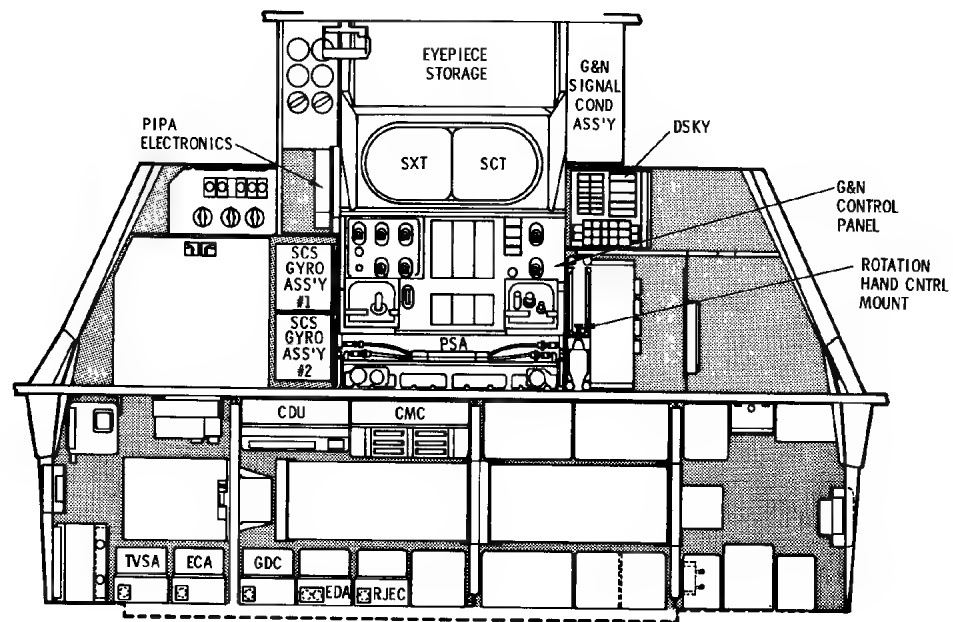


**GYRO ASSEMBLY  
(GA1, GA2)**

SCS-2010C 



## G&C EQUIPMENT LOCATION



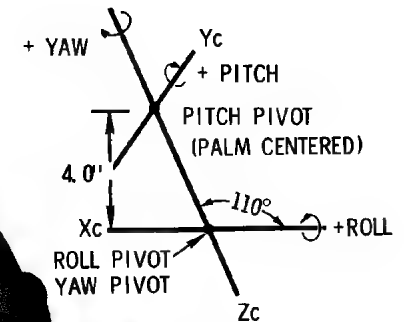
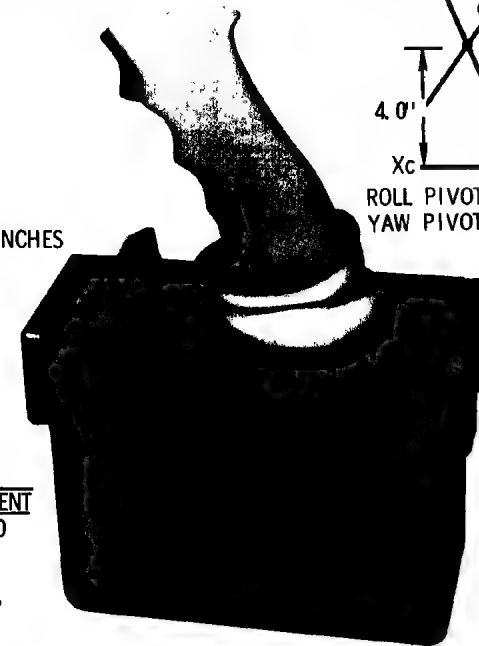
# ROTATION CONTROL

## PUSH TO TALK SWITCH PARAMETERS

TRAVEL PRIOR TO SWITCH ACTUATION	8.0° MIN
TRAVEL TO HARDSTOP	25.0° MAX
MAXIMUM TORQUE	1.0 POUND INCHES

## ROTATION CONTROL PARAMETERS

	<u>DISPLACEMENT</u>
HARD STOP	11.5±0.50
DIRECT SWITCH ACTUATION	≈11.0°
SOFT STOP	10±1°
BREAKOUT SWITCH ACTUATION	1.5± 0.5°
CONTROLLER LOCK TO ARM	50.0°



SCS-2002B



# TRANSLATION CONTROL

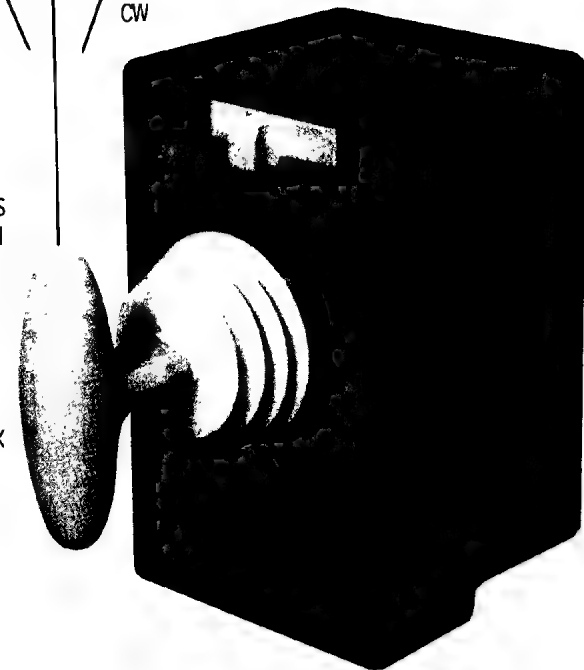
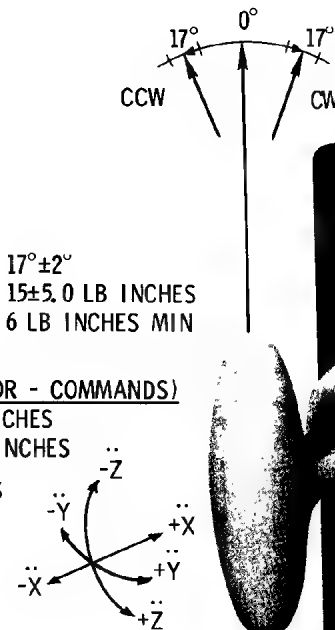
## CW & CCW CONTROL MOTION LIMITS

HARD STOP, DETENT & SWITCH CLOSURE  
FORCE INTO DETENT  
OUT OF DETENT

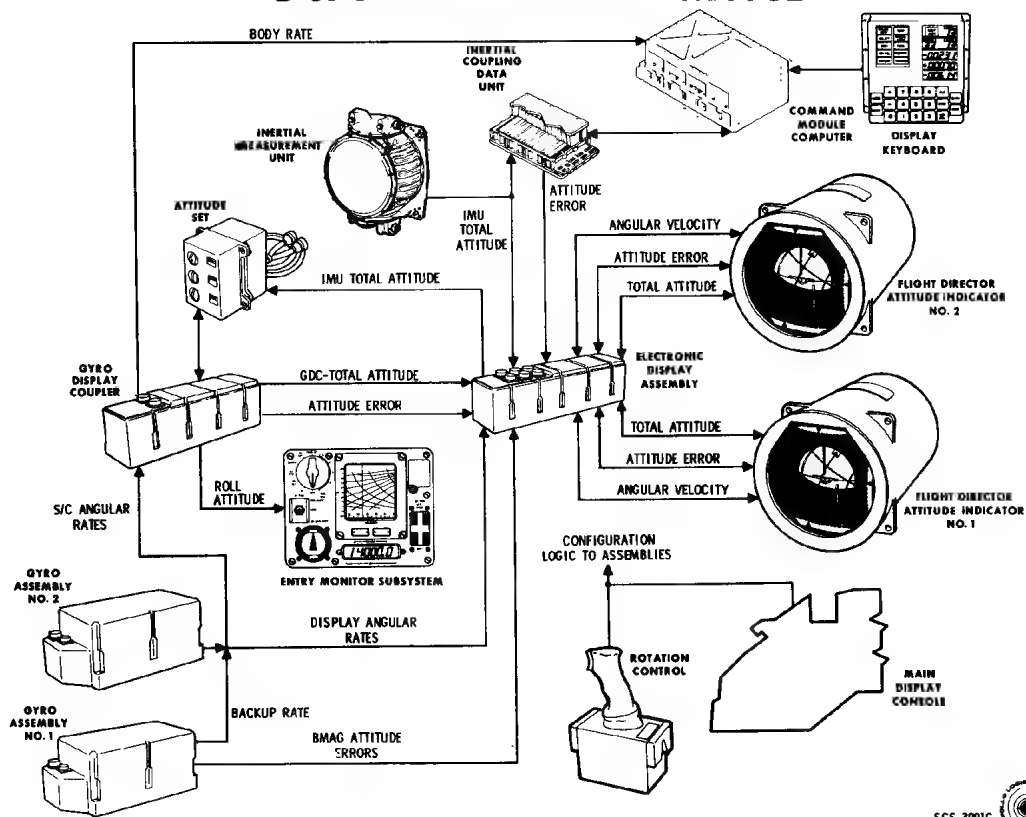
$17^{\circ} \pm 2^{\circ}$   
 $15 \pm 5.0$  LB INCHES  
6 LB INCHES MIN

## TRANSLATION CONTROL MOTION LIMITS (+ OR - COMMANDS)

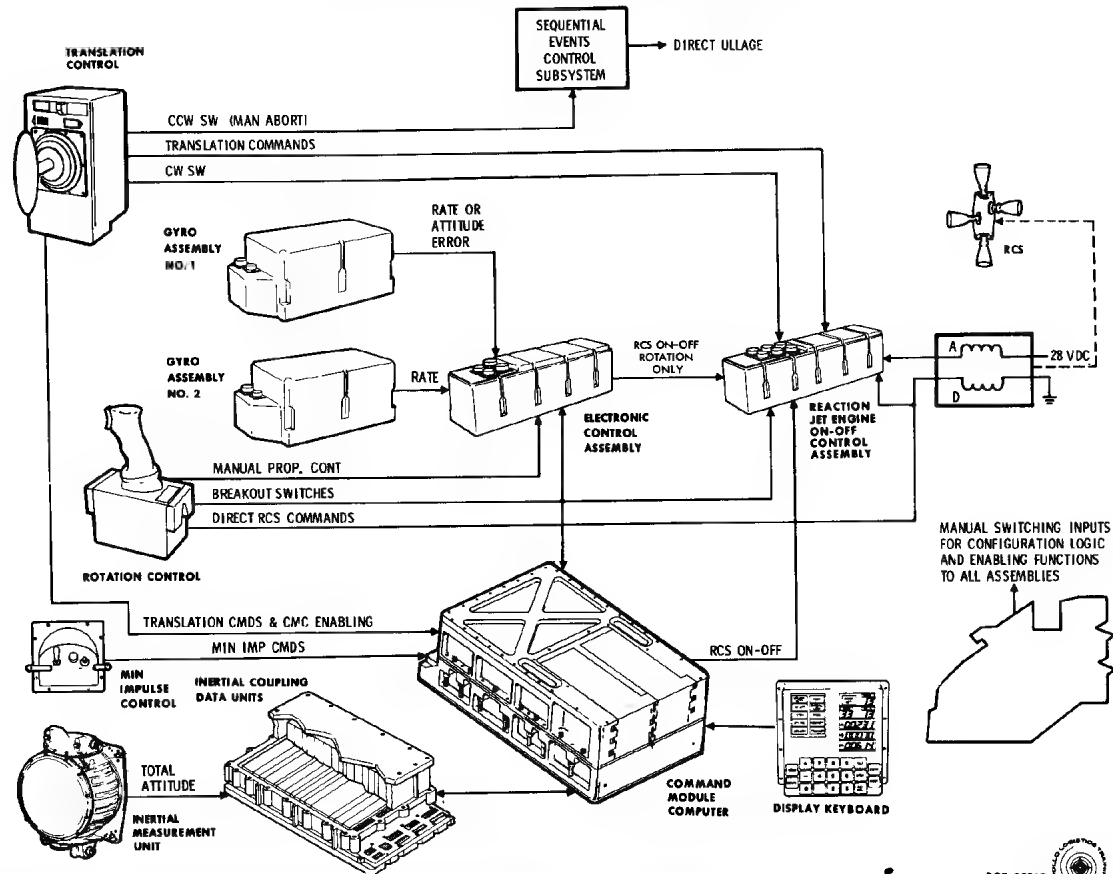
MECHANICAL STOP -  $0.5 \pm 0.075$  ARC INCHES  
SWITCH CLOSURE -  $0.375 \pm 0.025$  ARC INCHES  
FORCE -  $1.5 \pm 0.33$  POUNDS



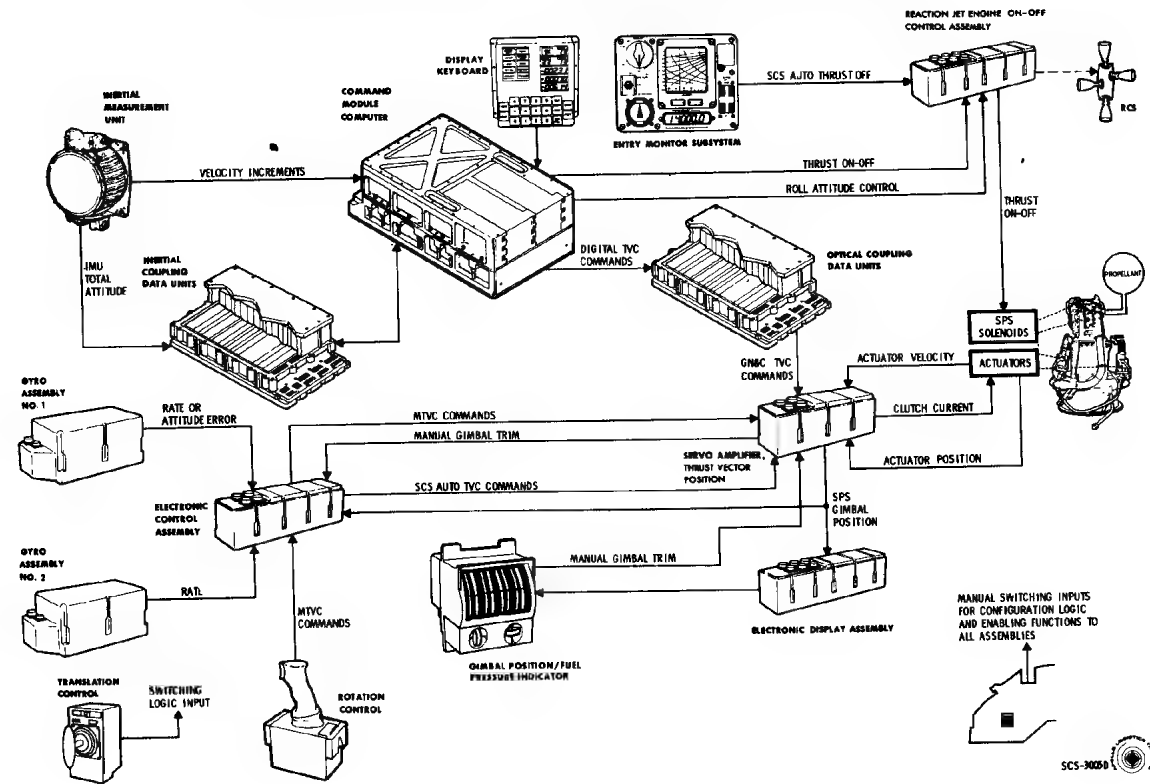
## G & C ATTITUDE REFERENCE



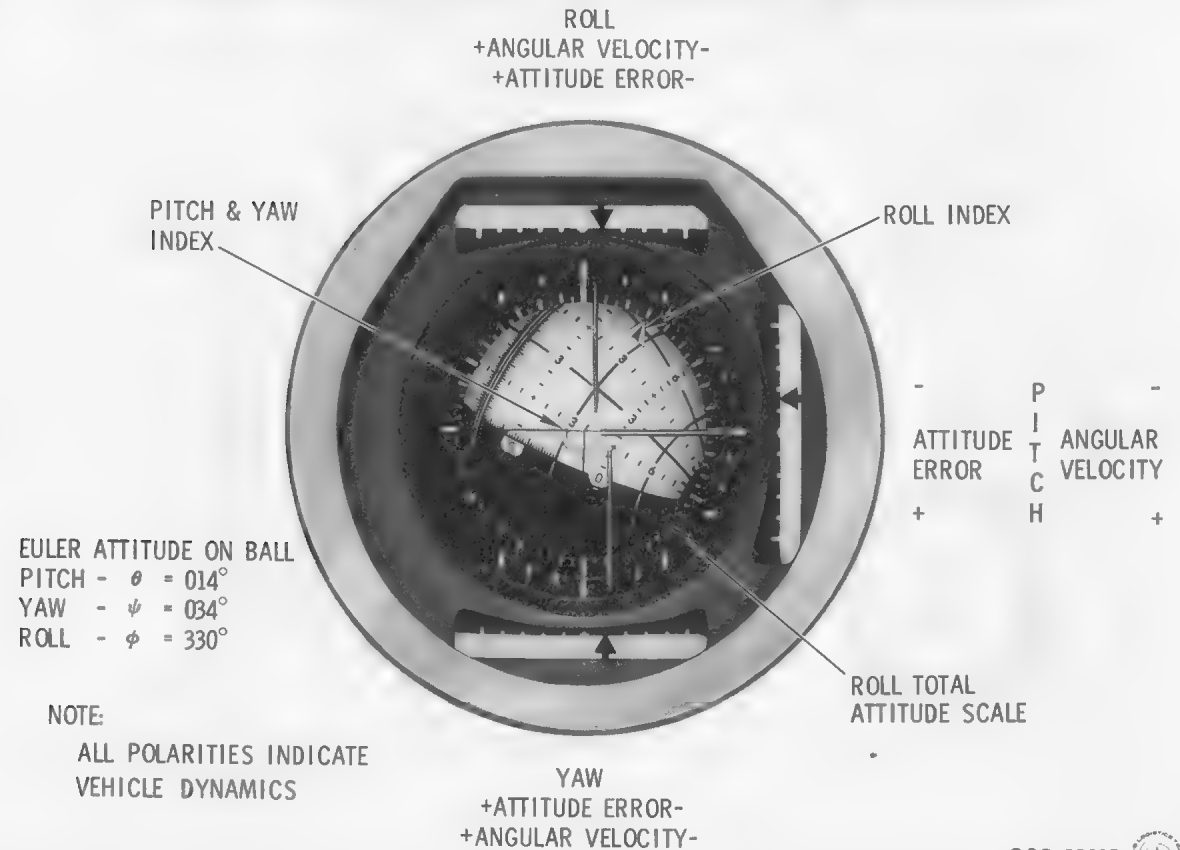
# G&C ATTITUDE CONTROL



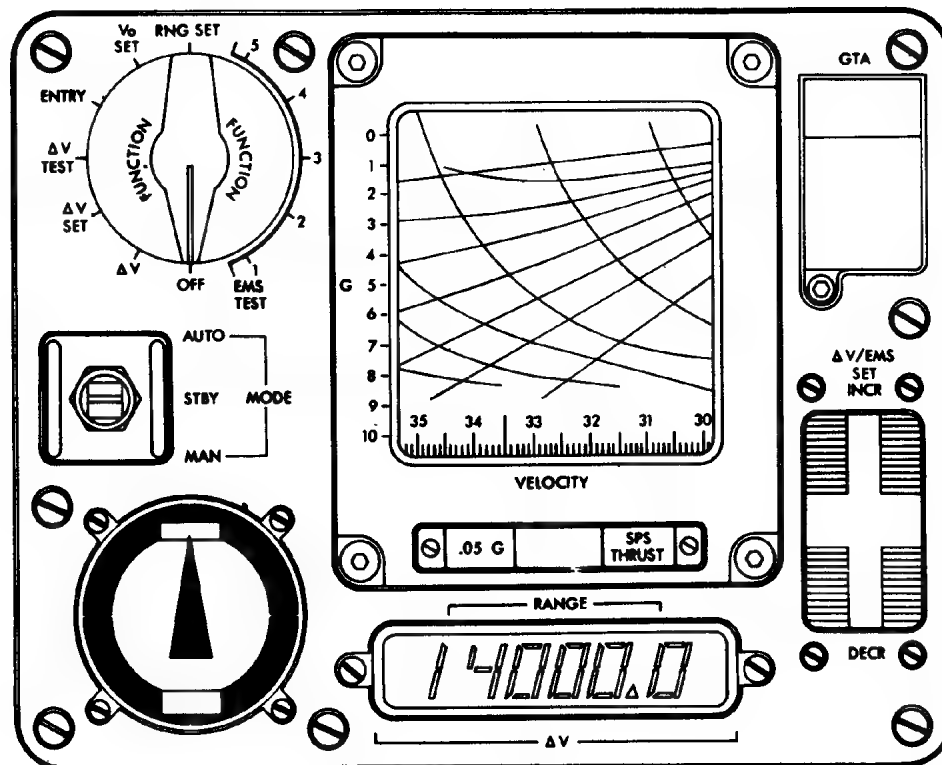
# G & C THRUST VECTOR CONTROL




# FLIGHT DIRECTOR ATTITUDE INDICATOR



SCS-2100D



FAM-6400 



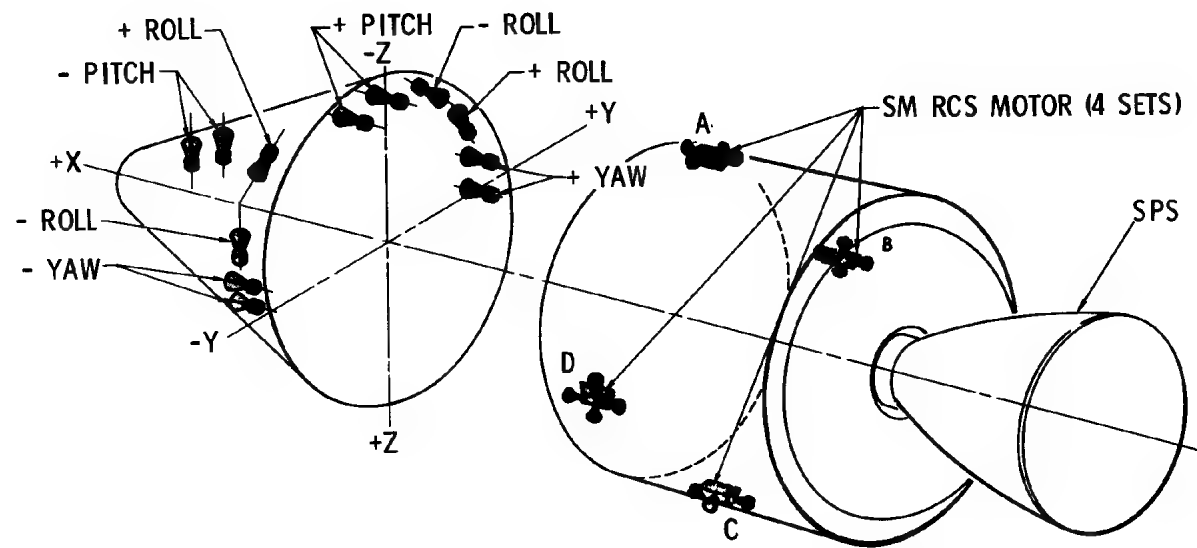
# PROPULSION

FAM-4000A



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# ENGINE LOCATION



## S/M REACTION CONTROL SYSTEM

PURPOSE: PROVIDE POWER FOR ATTITUDE AND/OR TRANSLATION  
CONTROL AFTER BOOSTER SEPARATION UNTIL C/M AND S/M SEPARATION

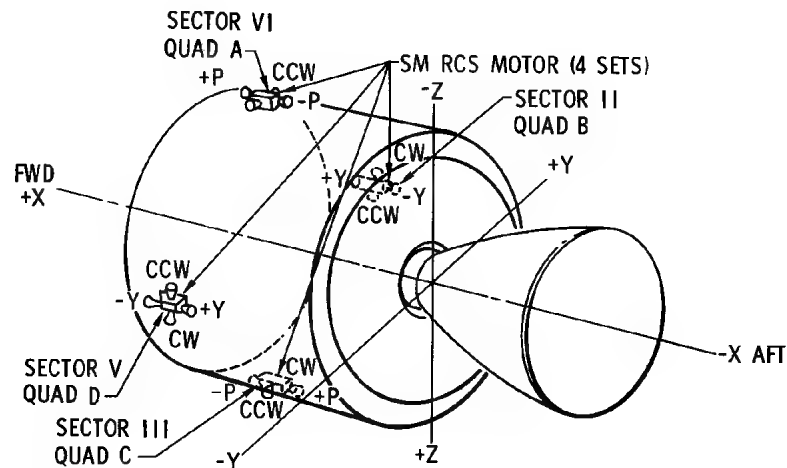
TYPE OF SYSTEM: NON THROTTLEABLE, PRESSURE FEED SYSTEM, HYPERGOLIC PROPELLANTS AND RADIANT COOLED THRUST CHAMBERS.

SYSTEM DESCRIPTION: FOUR INDIVIDUAL SUB-SYSTEMS

EACH SUBSYSTEM CONSISTS OF A SEPARATE PROPELLANT  
FEED SYSTEM AND FOUR THRUST CHAMBERS

PROPELLANTS - INHIBITED NITROGEN TETROXIDE AND MONOMETHYL HYDRAZINE

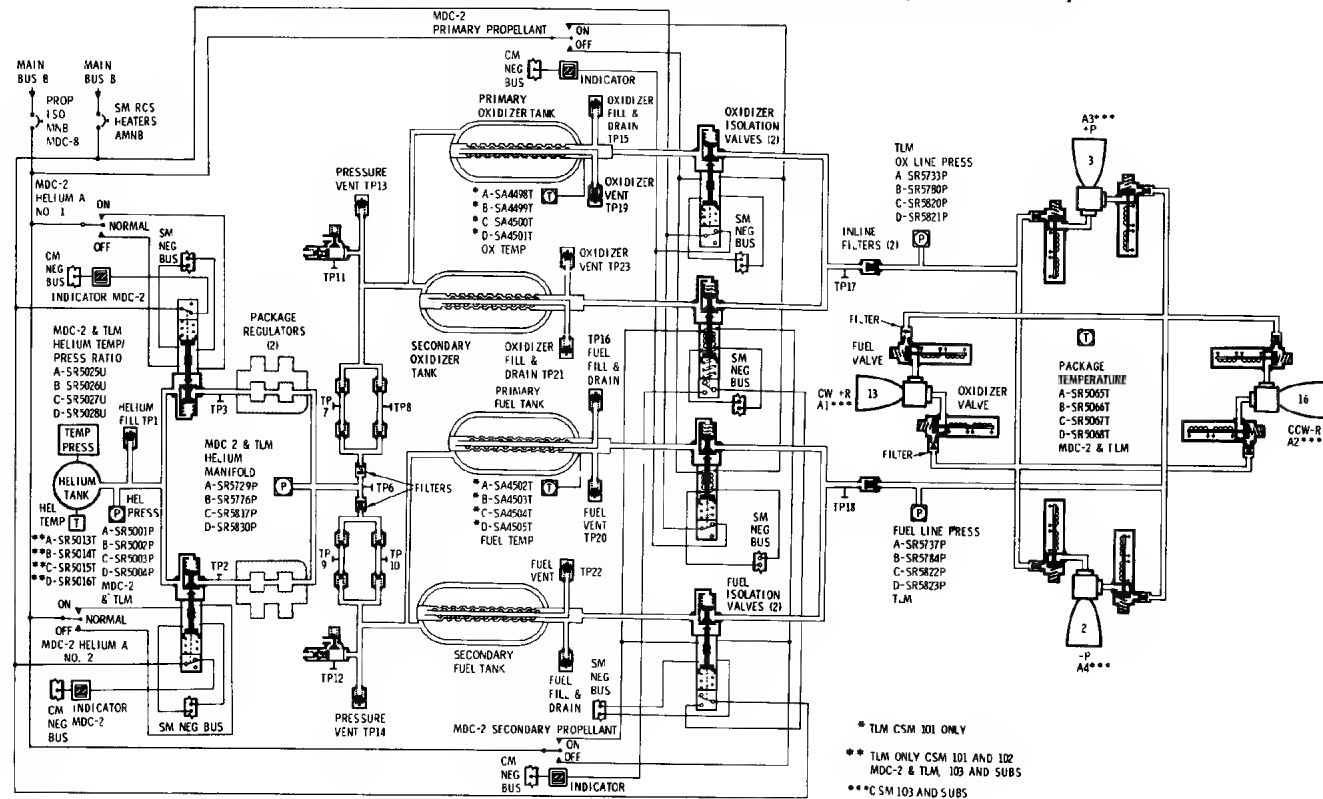
SYSTEM CONTROLLED BY CMC OR SCS WITH A MANUAL BACK-UP  
CAPABILITY



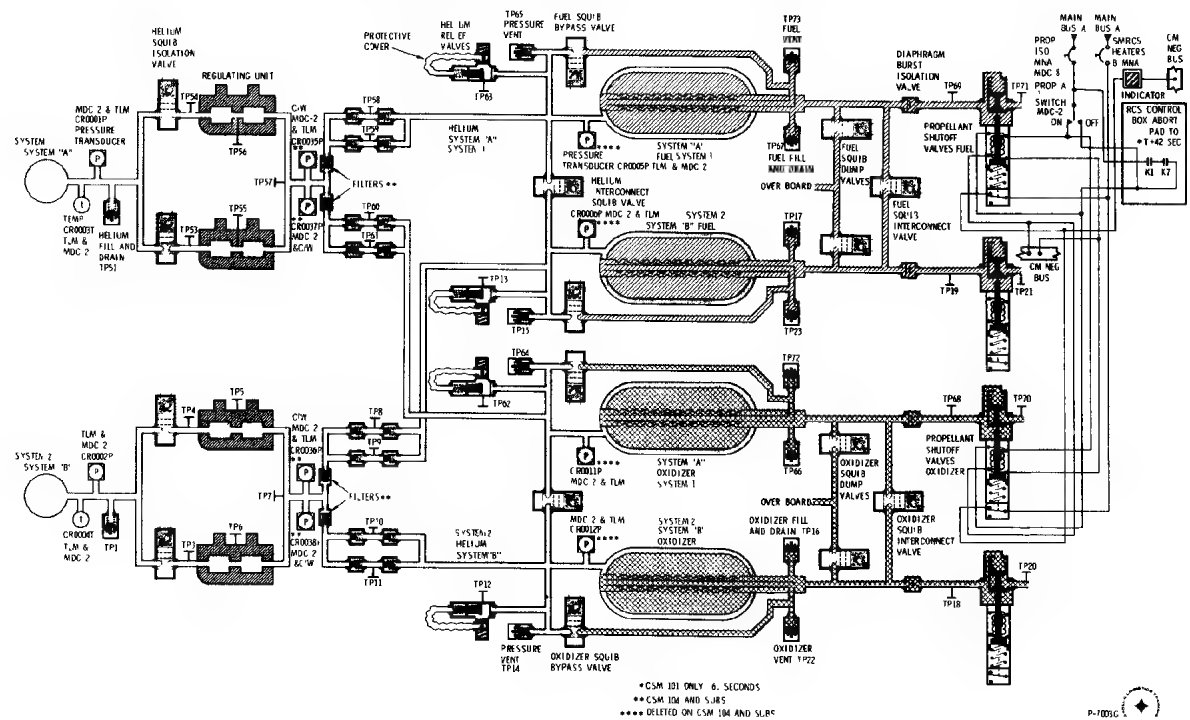
P-6000A

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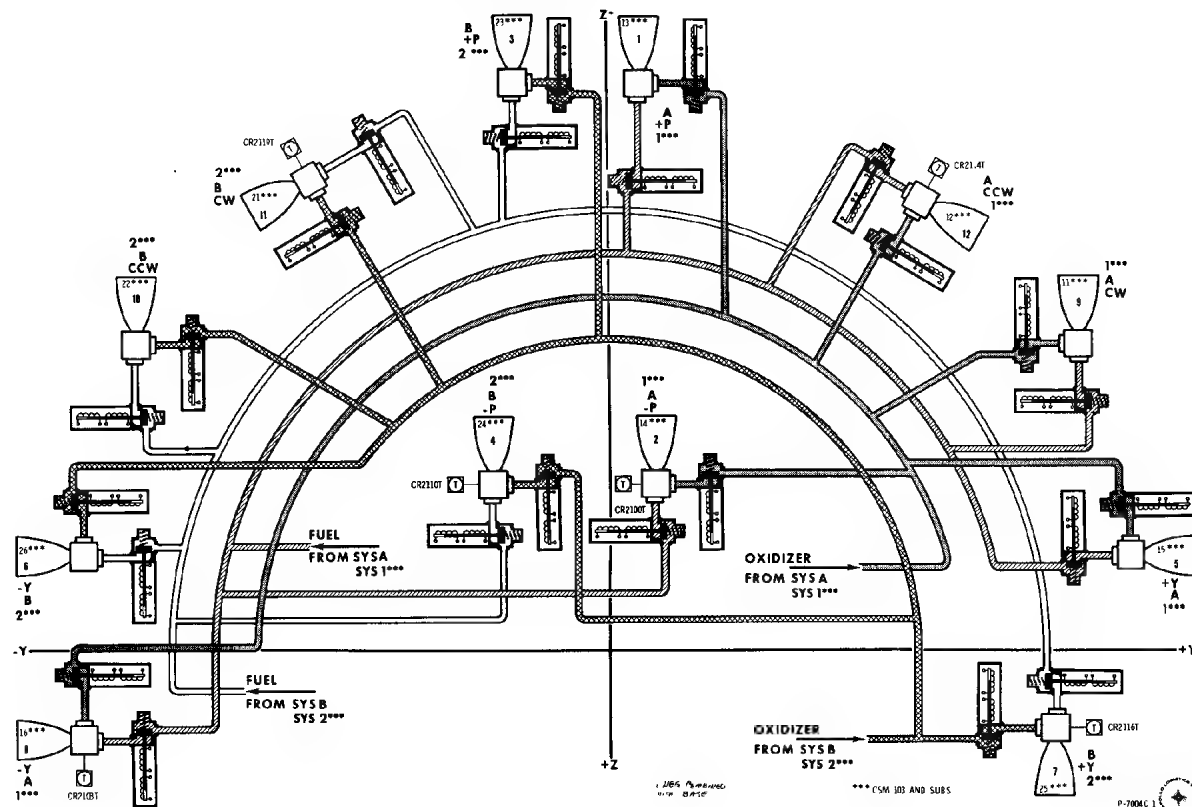
# SM REACTION CONTROL SUBSYSTEM (QUAD A)



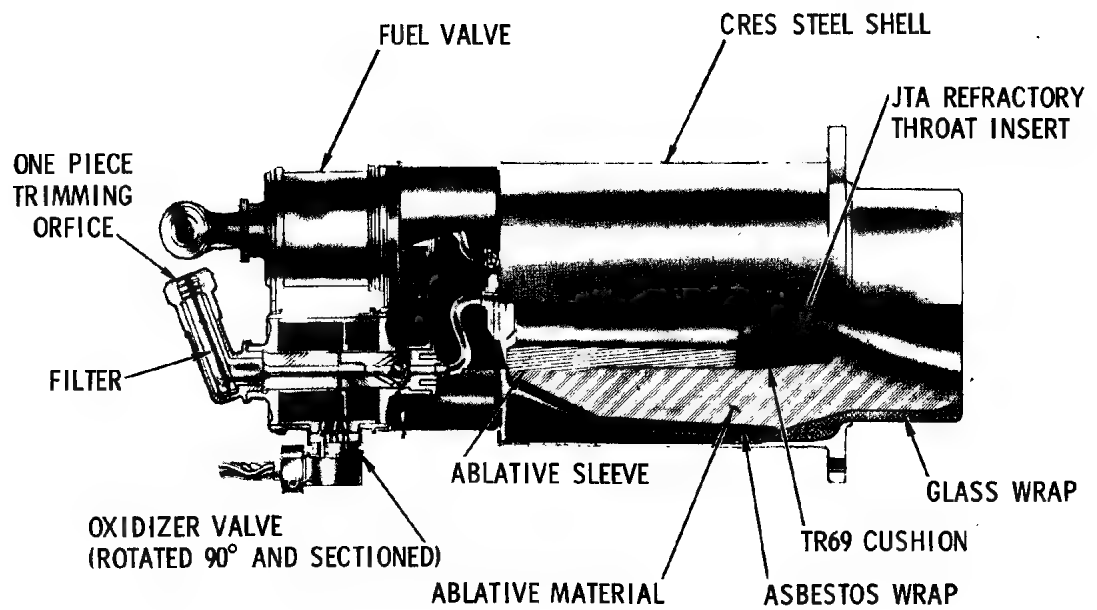
### PROPELLANT FEED SUBSYSTEM A&B



## 4

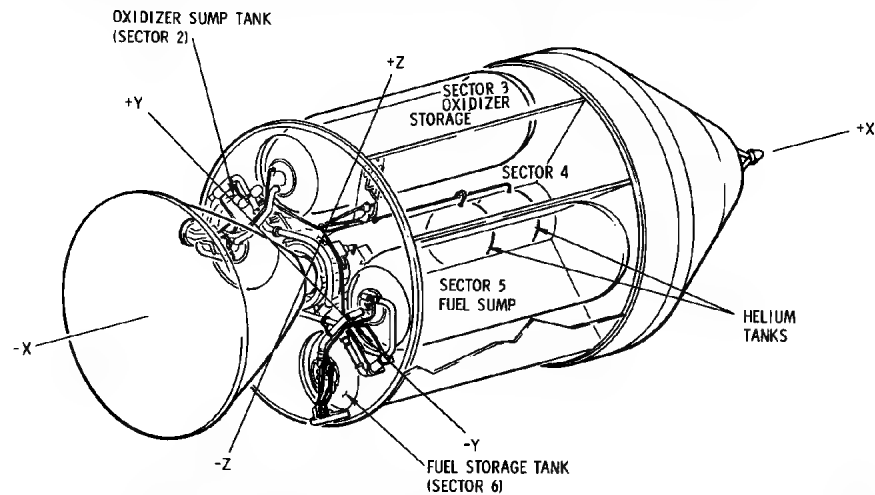


## CM RCS ENGINE





# SERVICE PROPULSION SYSTEM



TYPE OF SYSTEM: NON-THROTTLEABLE, PRESSURE FEED SYSTEM, HYPERGOLIC PROPELLANTS AND ABLATIVE CHAMBER WITH RADIANT COOLED NOZZLE EXTENSION.

SYSTEM DESCRIPTION: ONE SYSTEM CONSISTING OF A PROPELLANT FEED SYSTEM AND ONE ENGINE

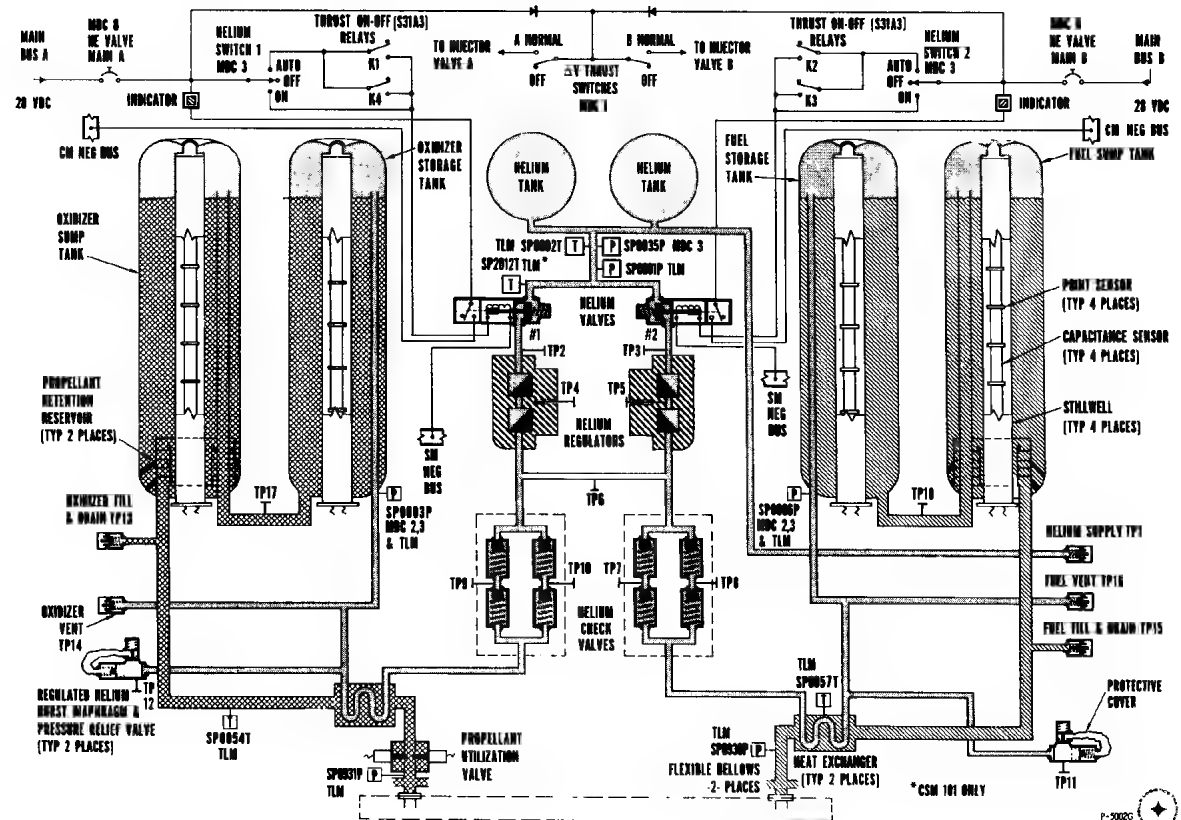
PROPELLANTS - INHIBITED NITROGEN TETROXIDE AND BLENDED HYDRAZINE (50% UDMH & 50% HYDRAZINE)

SYSTEM CONTROLLED BY CMC OR SCS WITH A MANUAL BACK-UP CAPABILITY

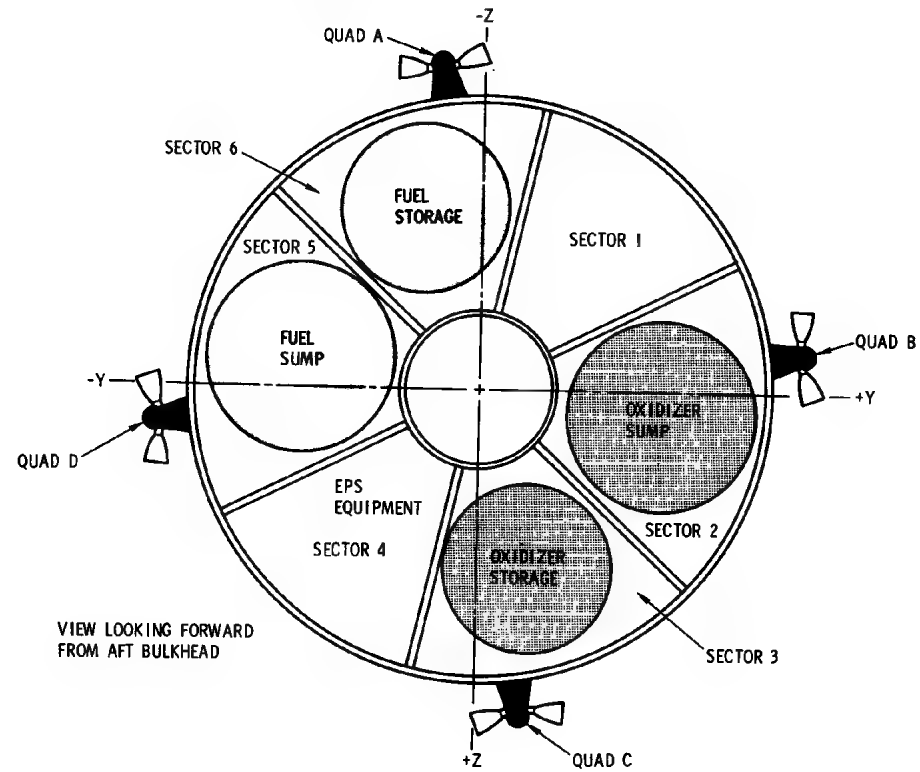
PURPOSE: PROVIDE THRUST FOR MAJOR VELOCITY CHANGES AFTER BOOSTER SEPARATION UNTIL C/M S/M SEPARATION. IN ADDITION SUPPORTS S/M ABORT AFTER THE LAUNCH ESCAPE TOWER HAS BEEN JETTISONED.

P-5078A

# SERVICE PROPULSION SYSTEM PROPELLANT FEED



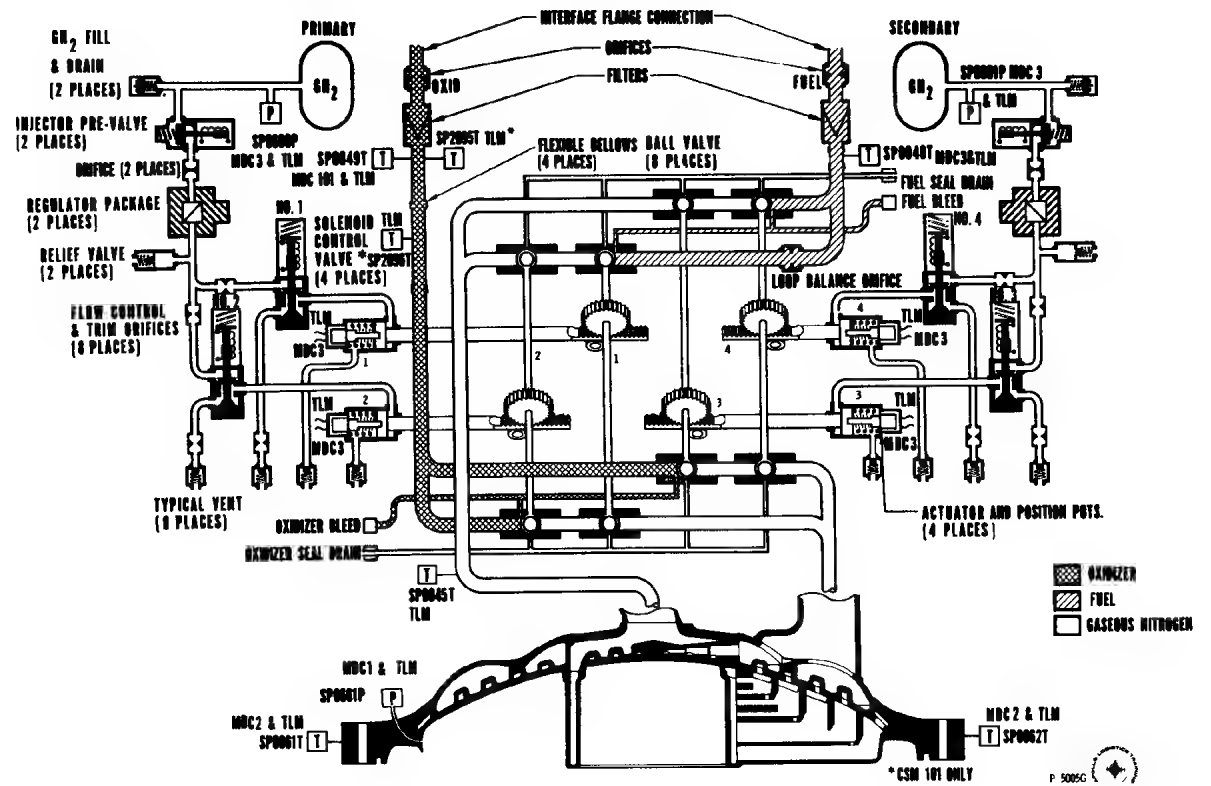
# SERVICE MODULE SECTORS



P-5038

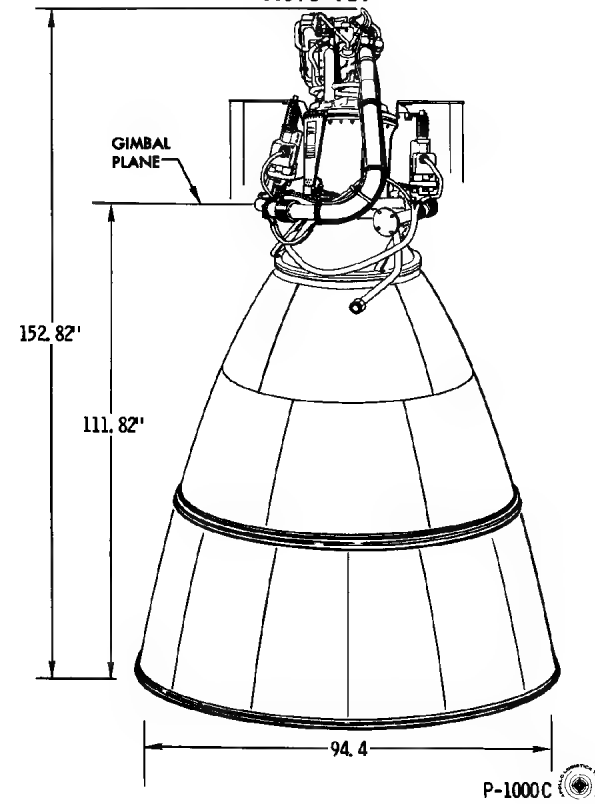


# SPS ENGINE PROPELLANT FEED

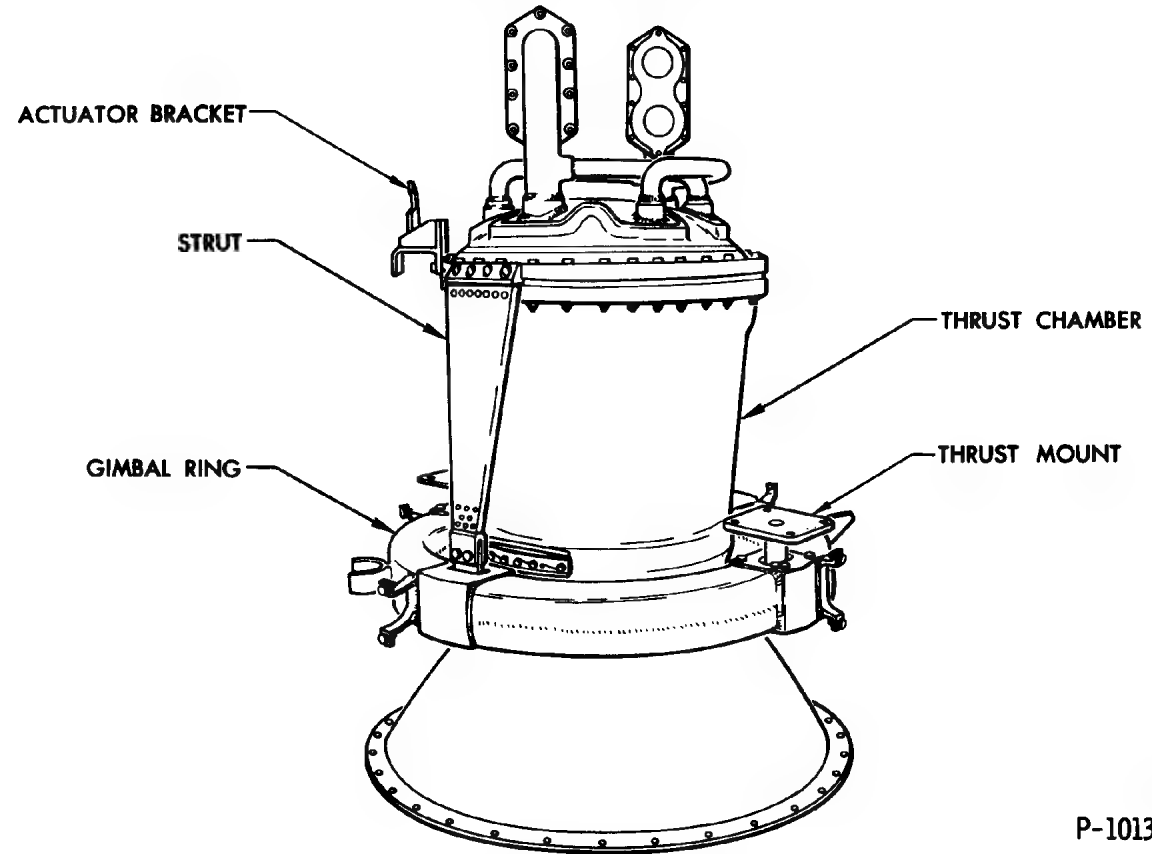


## SPS ROCKET ENGINE

AJ10-137



## SPS RING, STRUT & THRUST CHAMBER ASSEMBLY



# TELECOMMUNICATIONS

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# COMMUNICATIONS SYSTEM

## MISSION REQUIREMENTS

- DATA COLLECTION

CREW STATUS

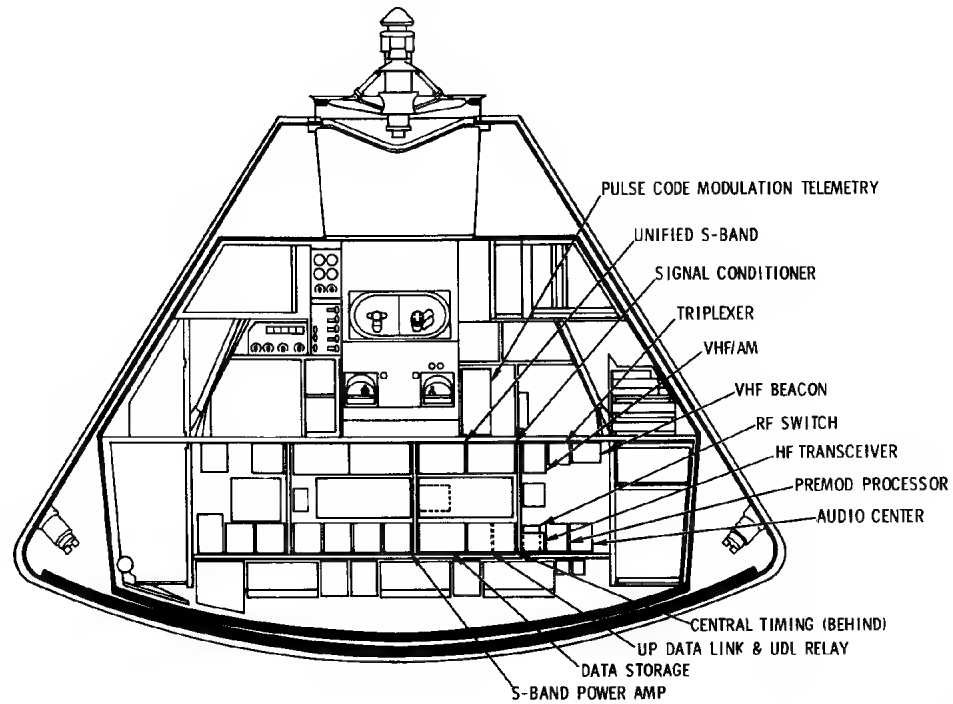
SYSTEM STATUS


- VOICE
- TV
- TRACKING
- RECOVERY BEACON
- UP DATA
- TAPE RECORDER



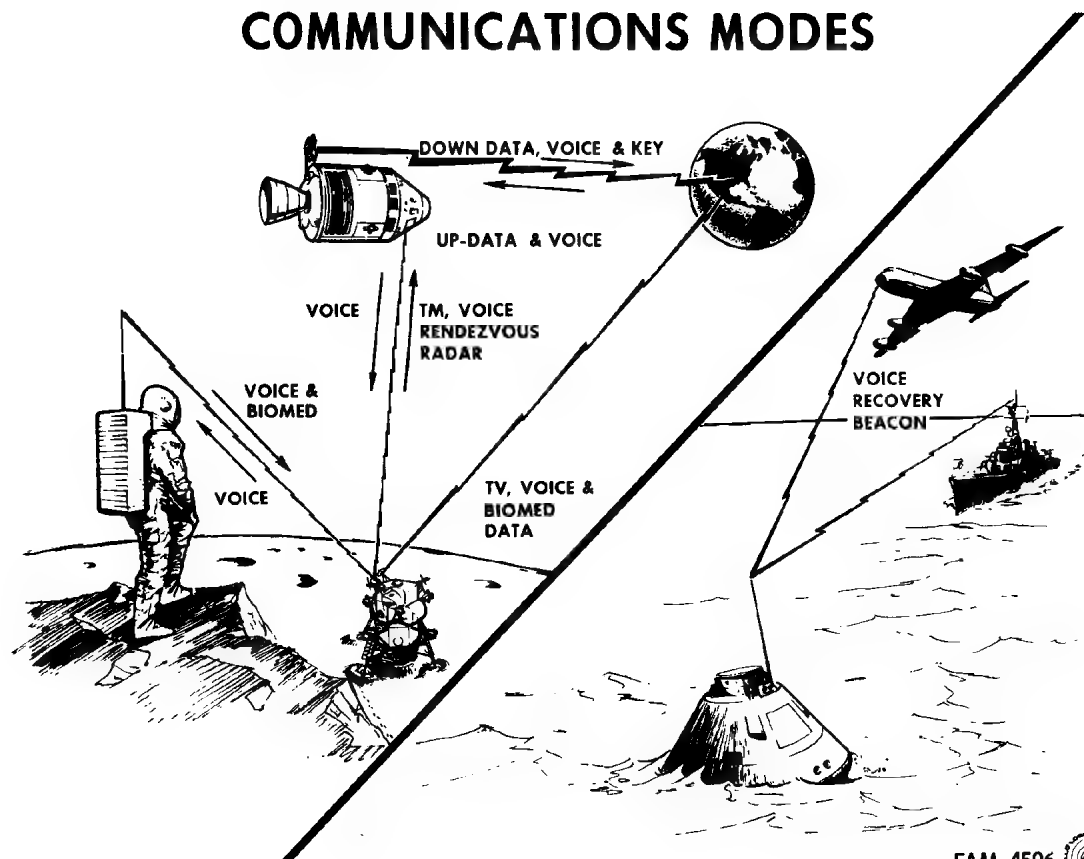
# TELECOMMUNICATIONS EQUIPMENT

LOWER EQUIPMENT BAY BLOCK II

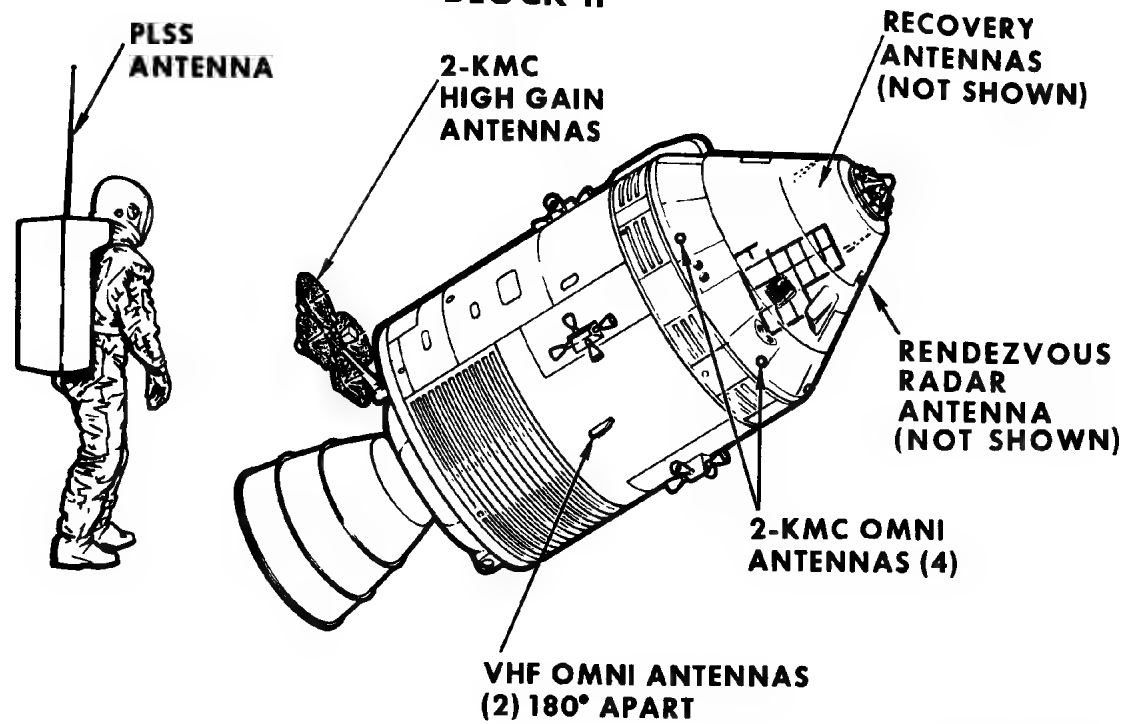


CD-2006 

## COMMUNICATIONS MODES

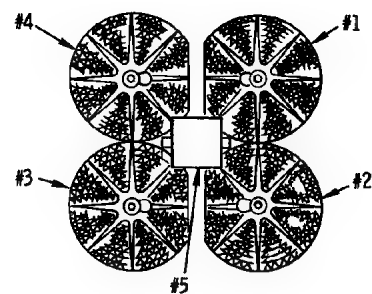


# COMMUNICATIONS SYSTEM BLOCK II



FAM-4507A 

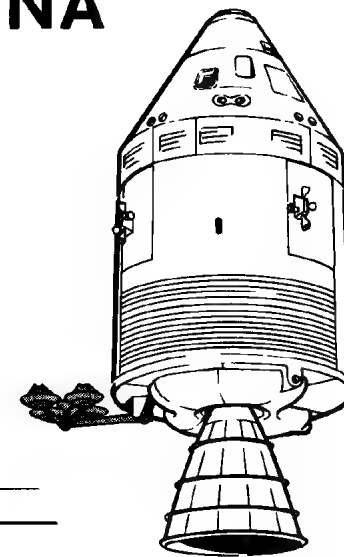
# BLOCK II S-BAND HI GAIN ANTENNA



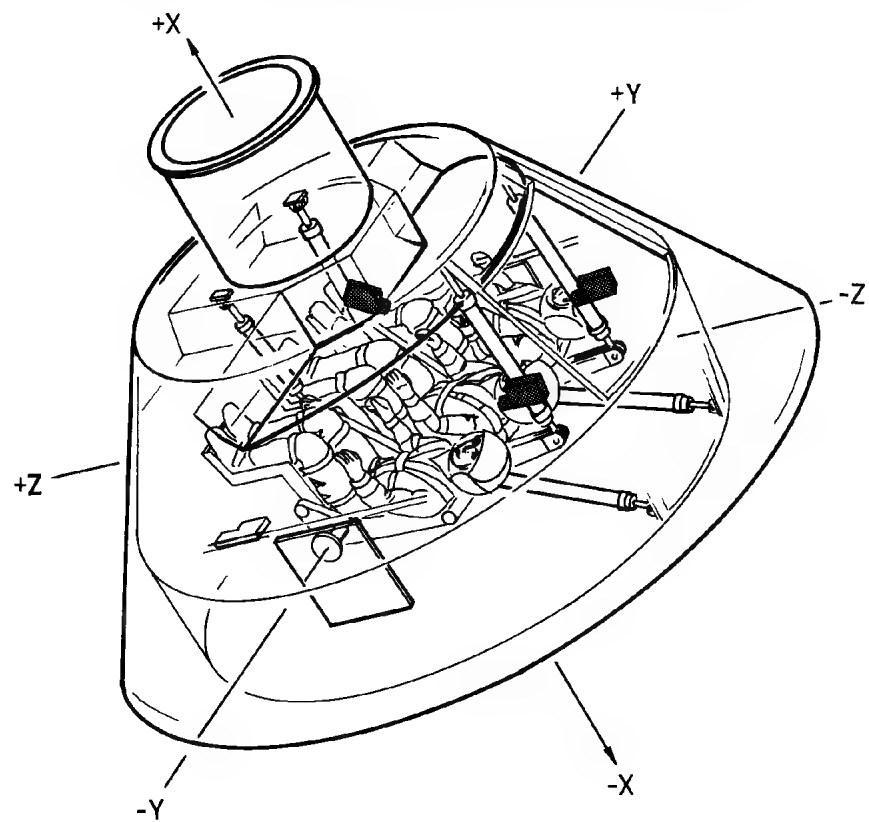
SOLAR RIB  
REFLECTORS  
≈ 31" DIA

FEEDHORNS  
10° OFFSET

FRONTVIEW

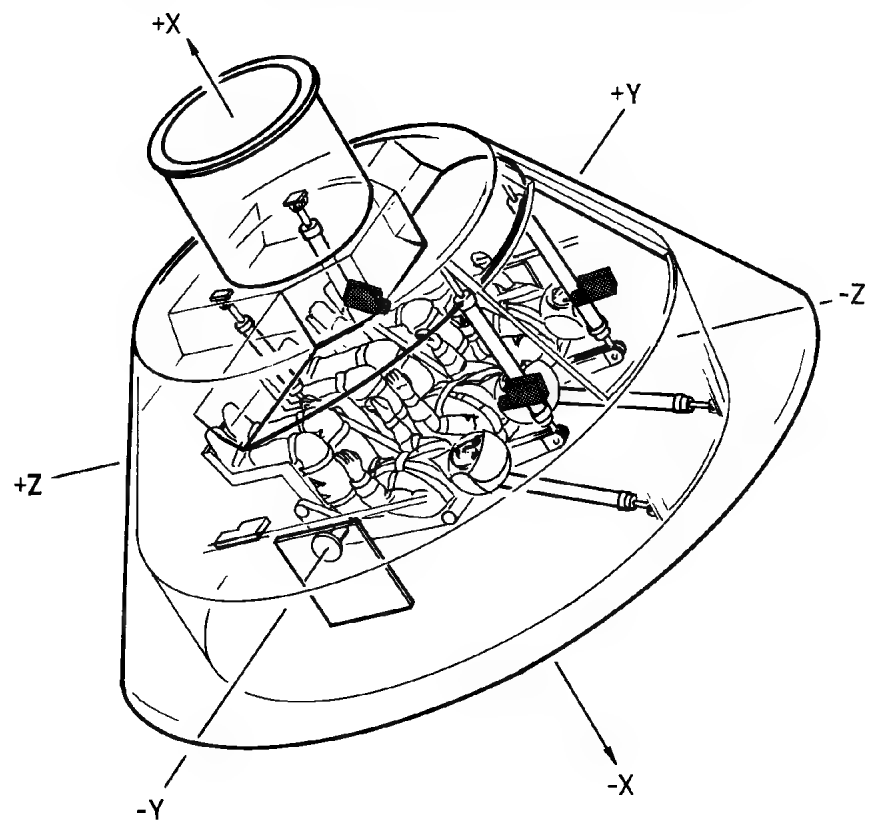


## TV CAMERA LOCATIONS



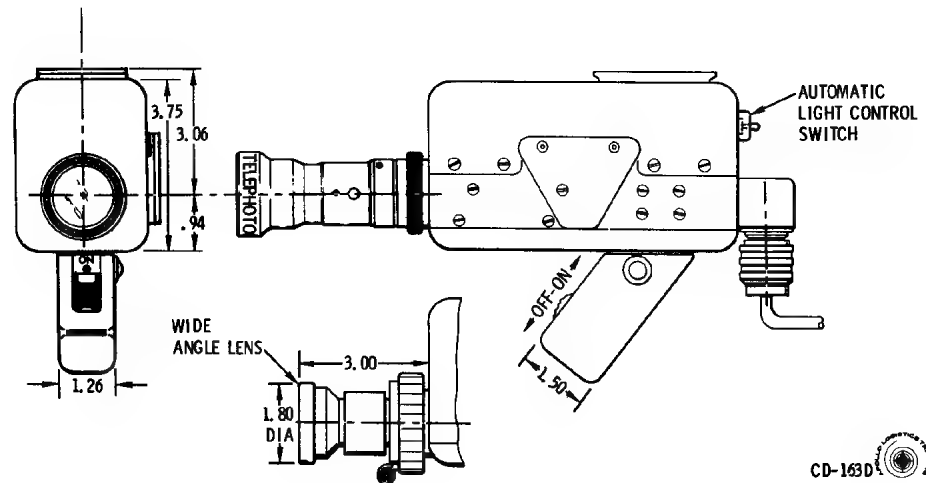
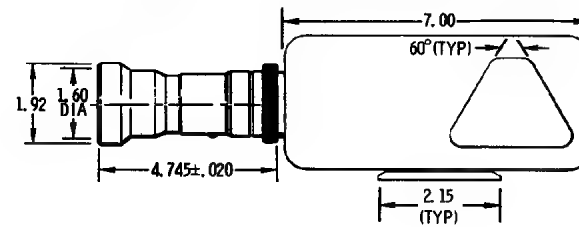
CD-2012B 

## TV CAMERA LOCATIONS



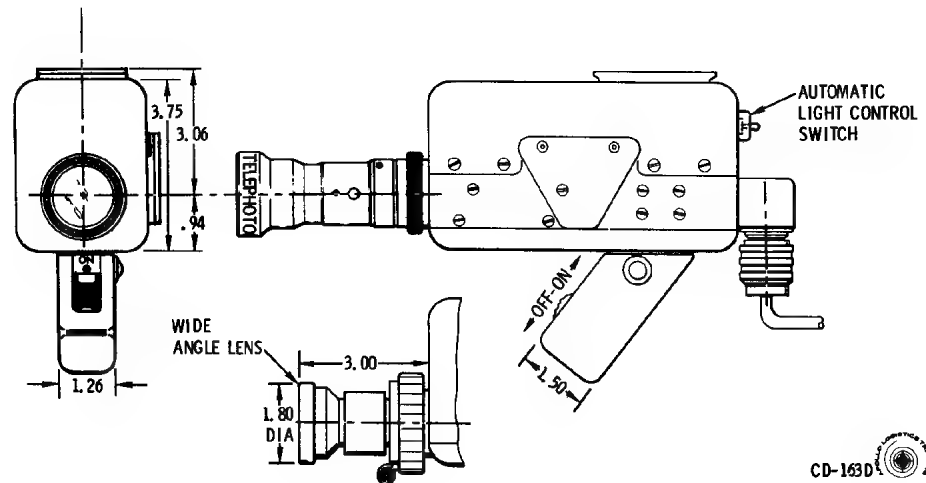
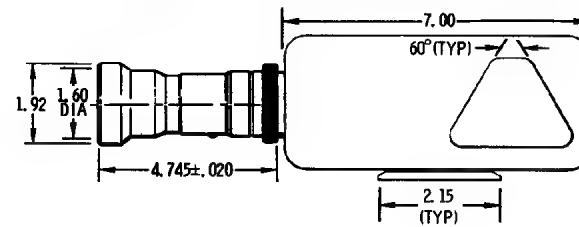
CD-2012B 

# 



CD-163D

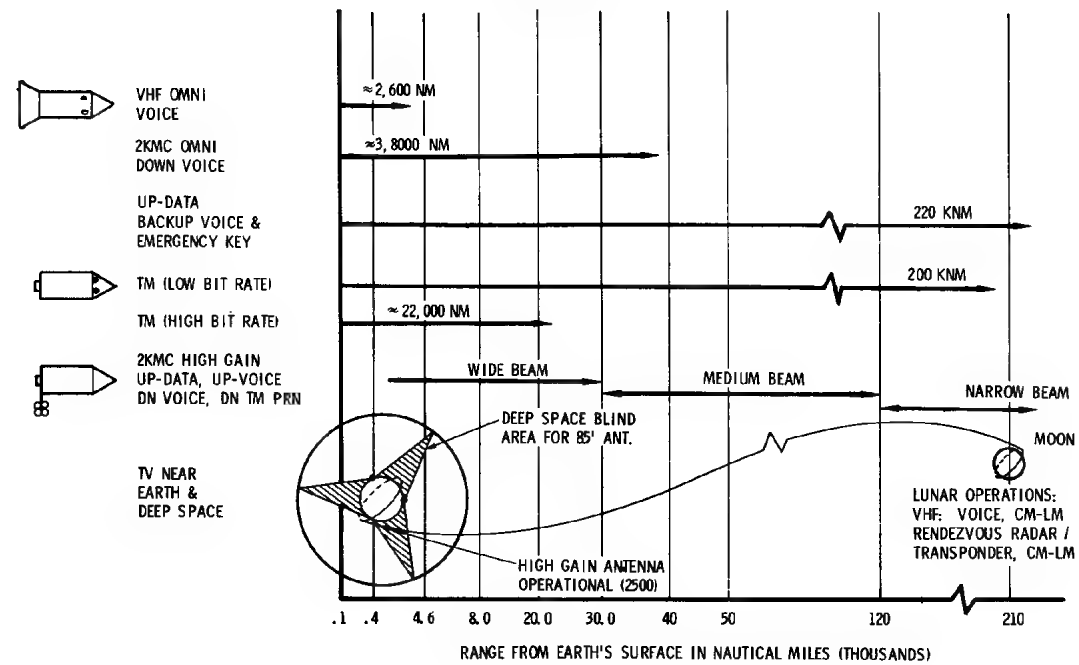
# 



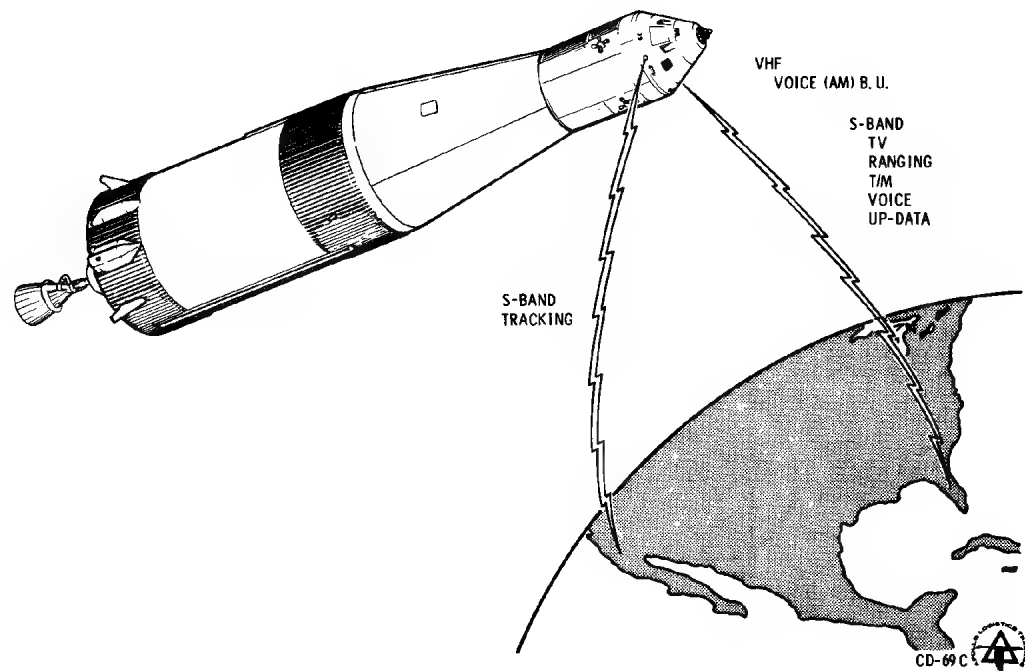
CD-163D



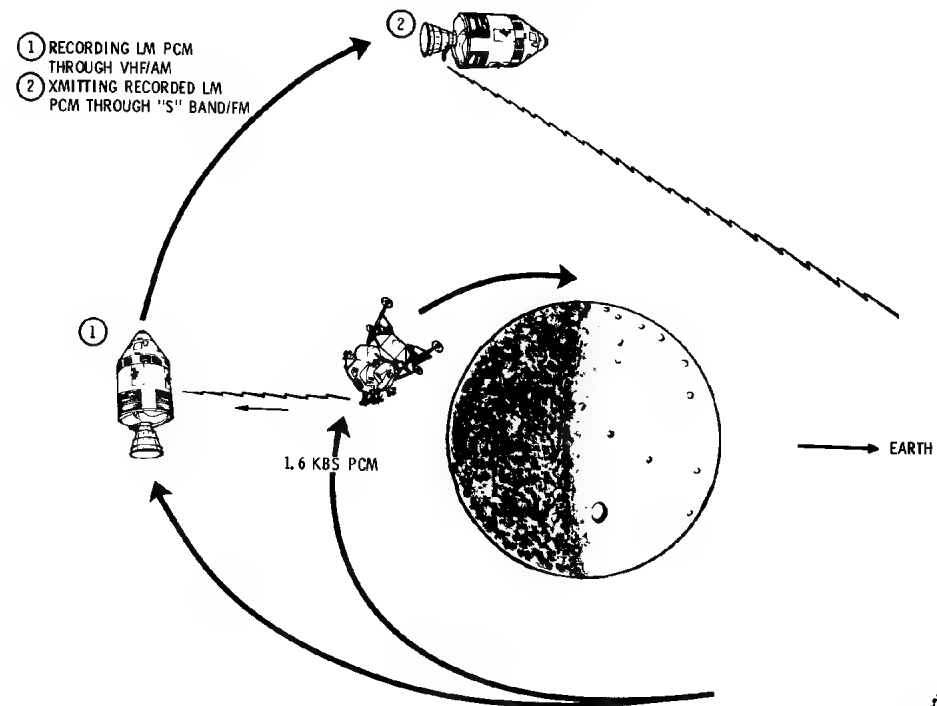
# CSM COMMUNICATIONS RANGES BLOCK II



## NEAR EARTH COMMUNICATION MODES



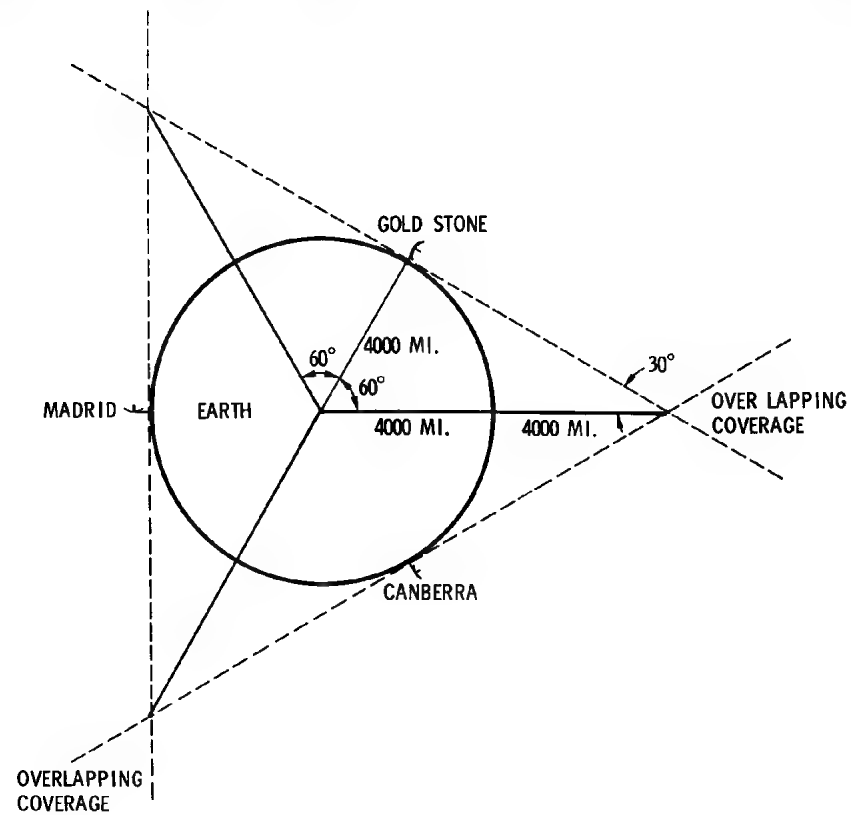
## LEM-CSM VHF/AM DATA REC



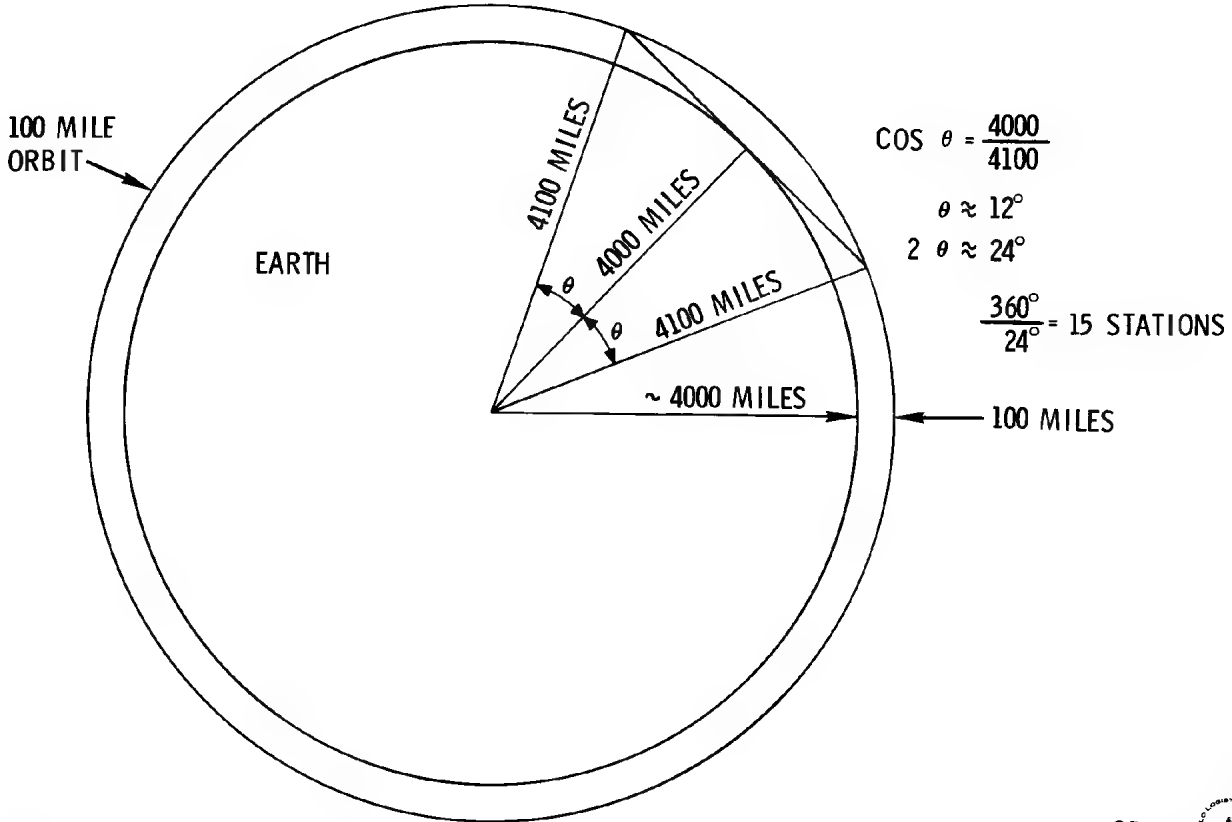
CD-2089B



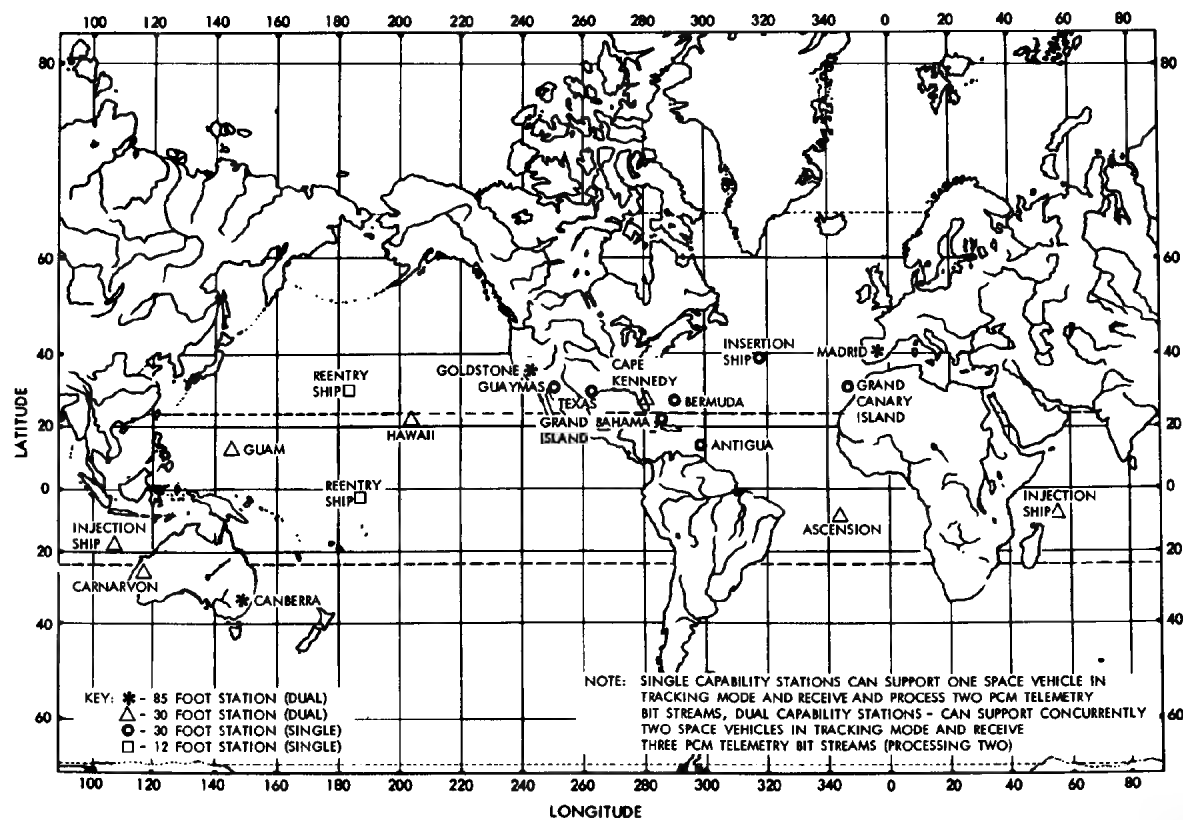
# S-BAND GROUND STATION GEOMETRY



## S-BAND GROUND STATION REQ



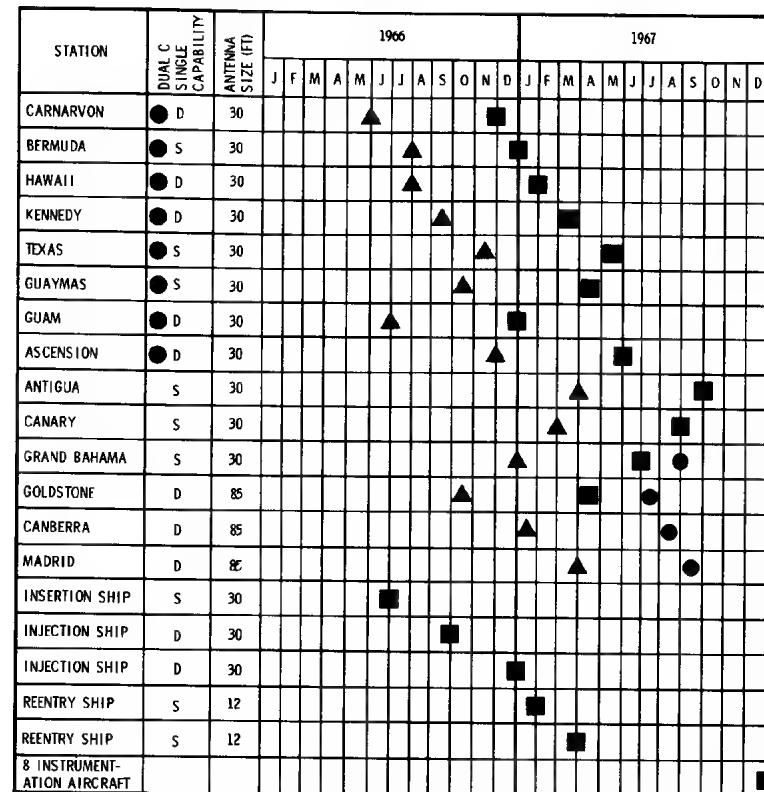
## BLOCK I & II MSFN S-BAND STATION LOCATIONS



CD-62



# MSFN S- BAND IMPLEMENTATION SCHEDULE



COMPLETE INSTALLATION AND CHECKOUT \_\_\_\_\_ ▲  
FULLY OPERATIONAL-MANNED MISSIONS \_\_\_\_\_ ●

COMPLETE SYSTEM SIMULATION \_\_\_\_\_ ■

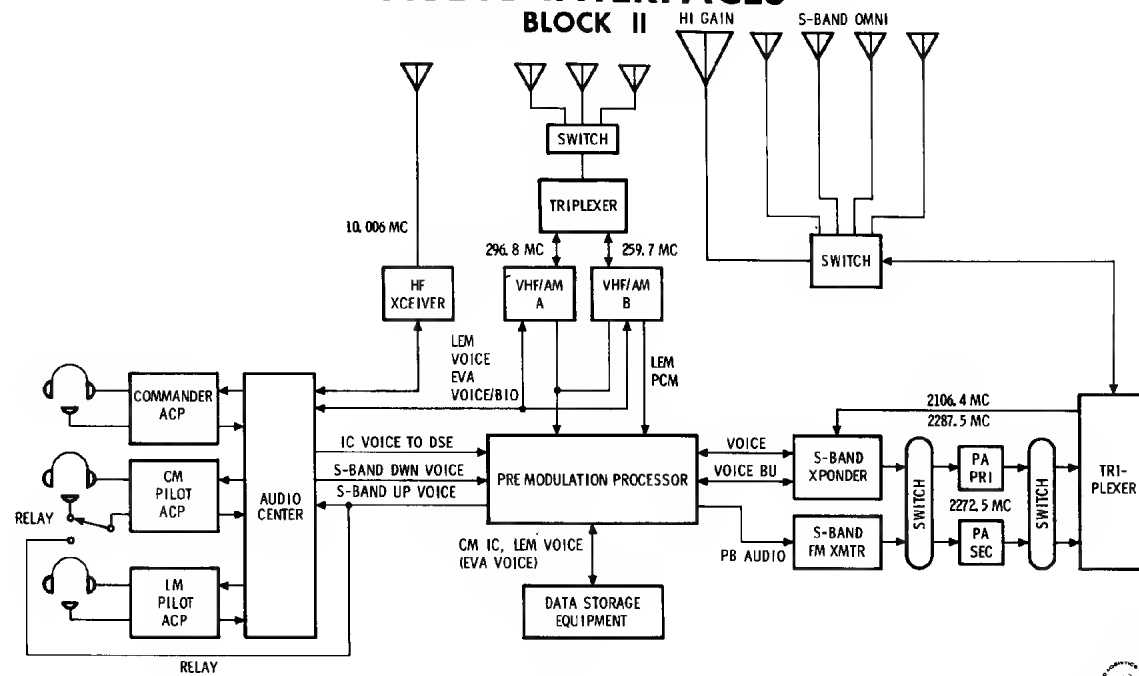
## COMM EQUIPMENT/MISSION PHASE

	PRE-LAUNCH	LAUNCH EARTH ORBIT TRANS- LUNAR INJECT.	TRANS- LUNAR FLIGHT 4000 MI	LUNAR ORBIT	LEM DESCENT LUNAR EXPLORE LEM ASCENT	TRANS- EARTH INJECT TRANS EARTH FLIGHT	DESCENT LANDING RECOVERY
VOICE	HARDLINE S-BAND	S-BAND VHF/AM*	S-BAND	S-BAND	S-BAND VHF/AM+	S-BAND	S-BAND VHF/AM
TV	HARDLINE	S-BAND	S-BAND	S-BAND	S-BAND	S-BAND	
BIO MED	HARDLINE S-BAND*	S-BAND	S-BAND VHF/AM+	S-BAND	S-BAND VHF/AM+	S-BAND	
UP-DATA	HARDLINE S-BAND*	S-BAND	S-BAND	S-BAND	S-BAND	S-BAND	
DWN- DATA	HARDLINE S-BAND*	S-BAND	S-BAND	S-BAND	S-BAND	S-BAND	
RANGING		S-BAND	S-BAND	S-BAND	S-BAND	S-BAND	
BEACON							VHF-BCN

\* BACKUP MODE  
+ LM-E. V. A. COMMUNICATIONS



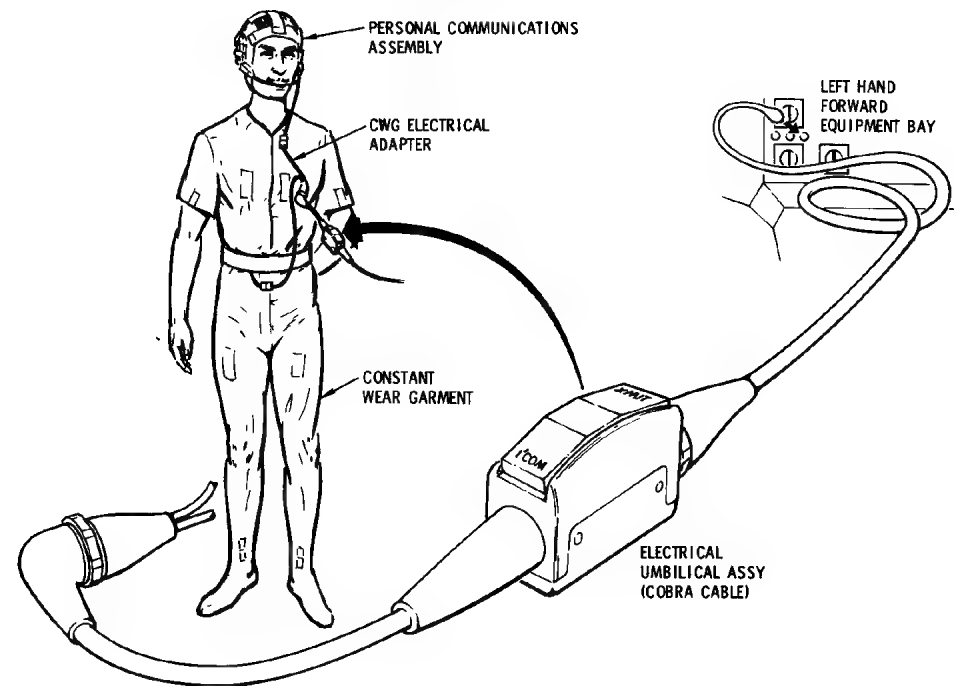
# AUDIO INTERFACES



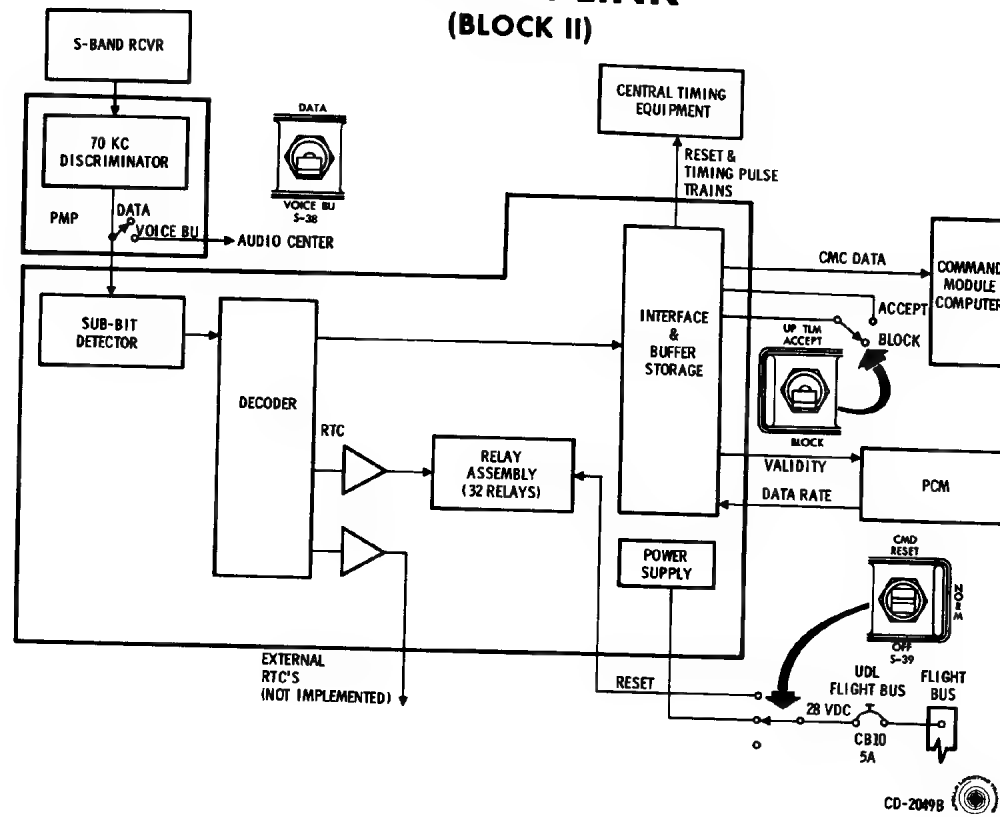
CD-2040-1B

# ELECTRICAL UMBILICAL (COMM CABLE)

## BLOCK II



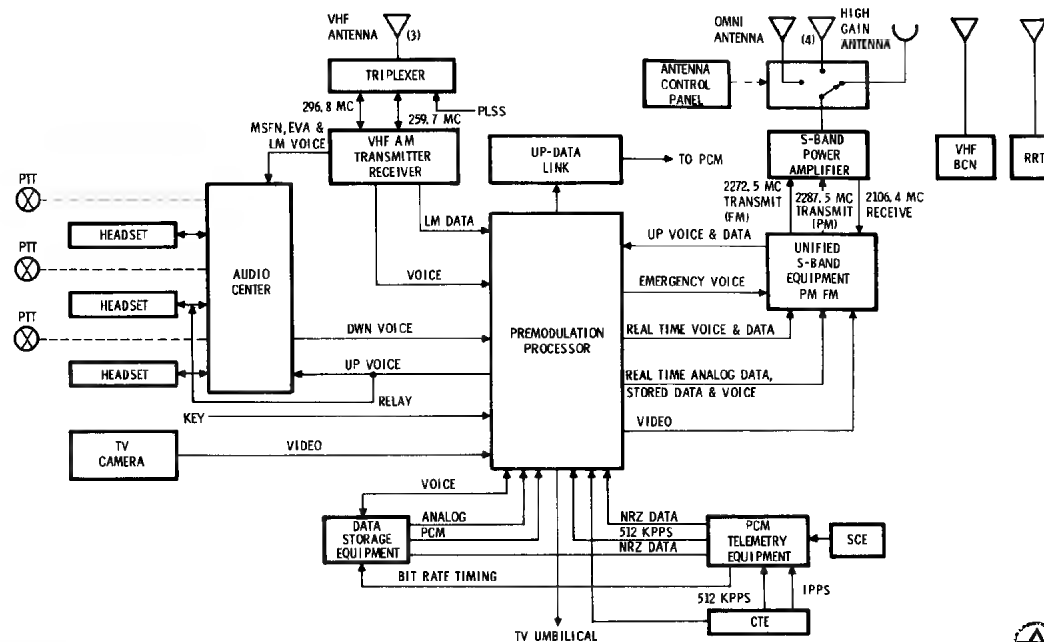
## UP-DATA LINK (BLOCK II)



## BLOCK II



# TELECOMMUNICATIONS SYSTEM BLOCK II



FAM-4508C



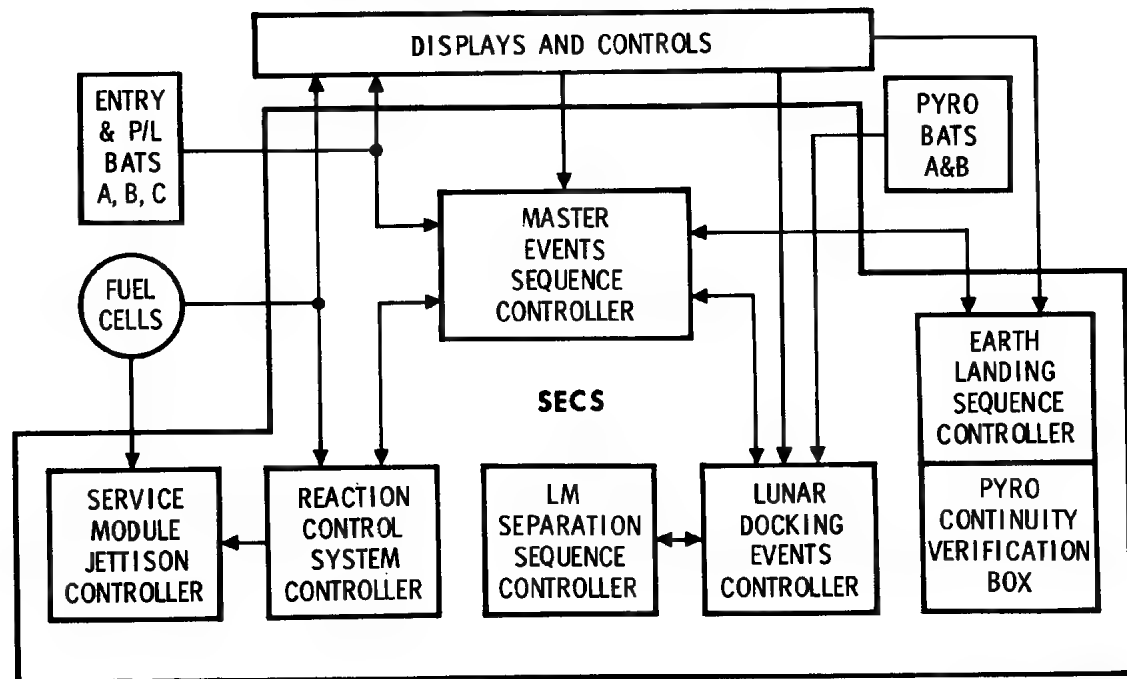
# SEQUENCING

FAM-3005B



# SECS

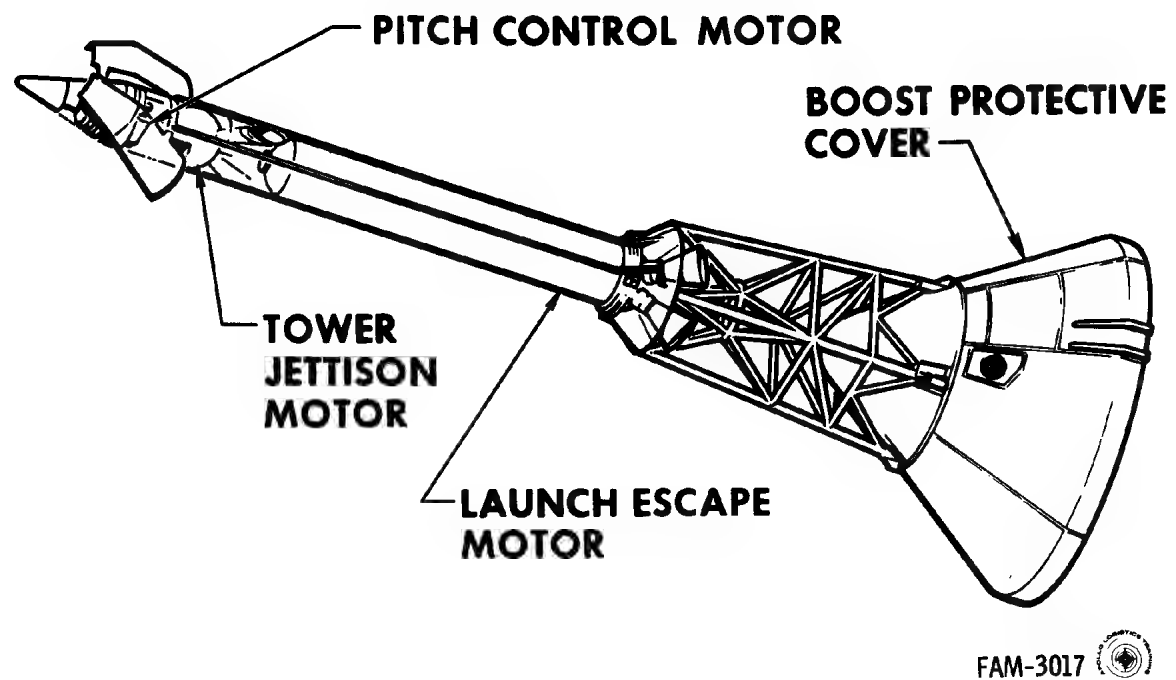
## MAJOR COMPONENTS (BLOCK II)



SEQ-501B

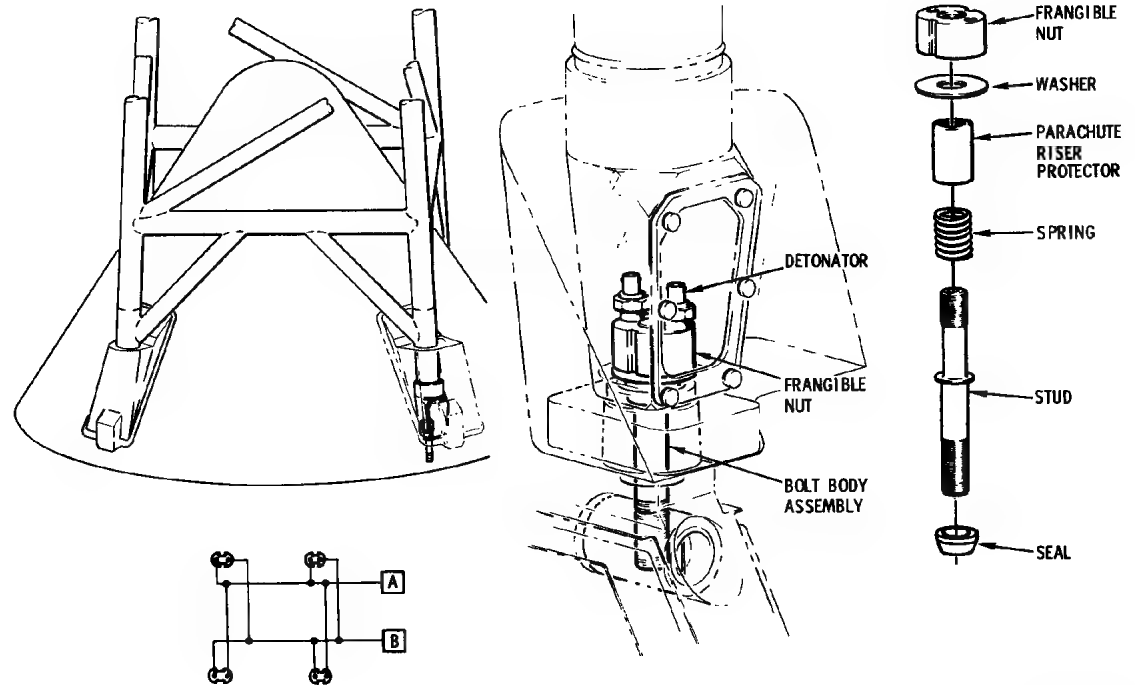


## LAUNCH ESCAPE SYSTEM & BOOST PROTECTIVE COVER

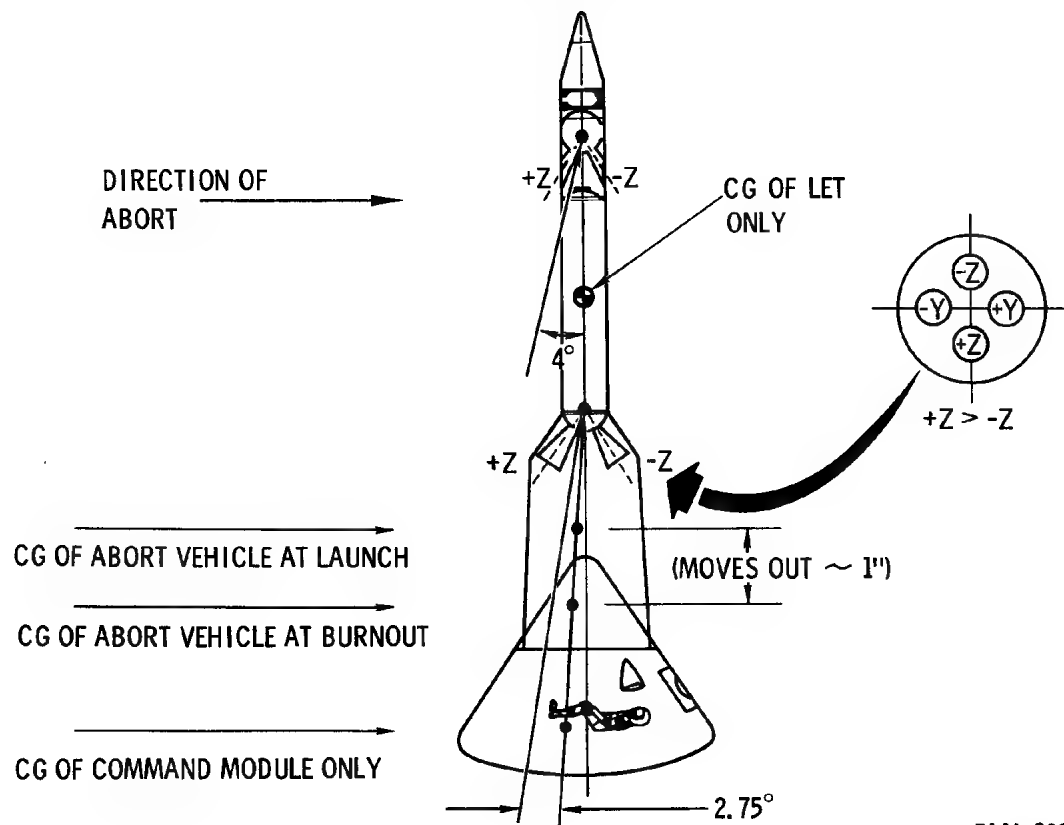




# TOWER SEPARATION SYSTEM

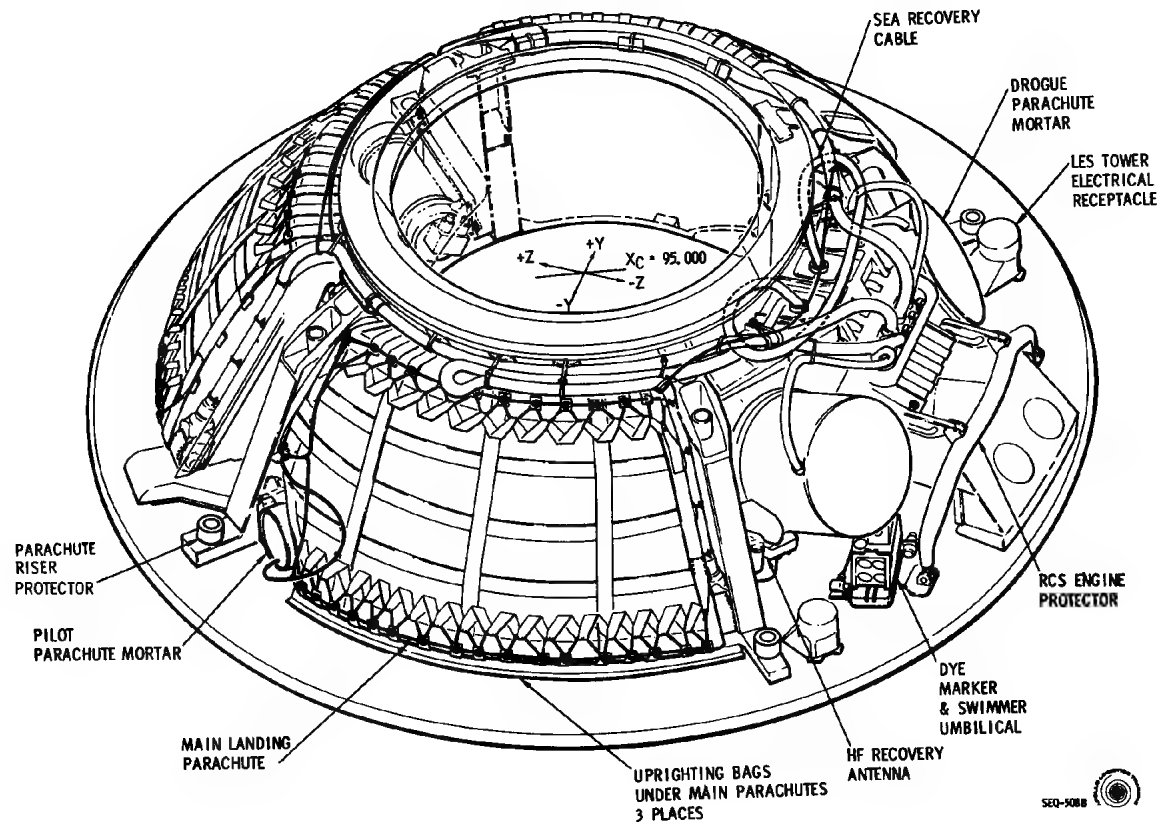


# ABORT VEHICLE MECHANICS

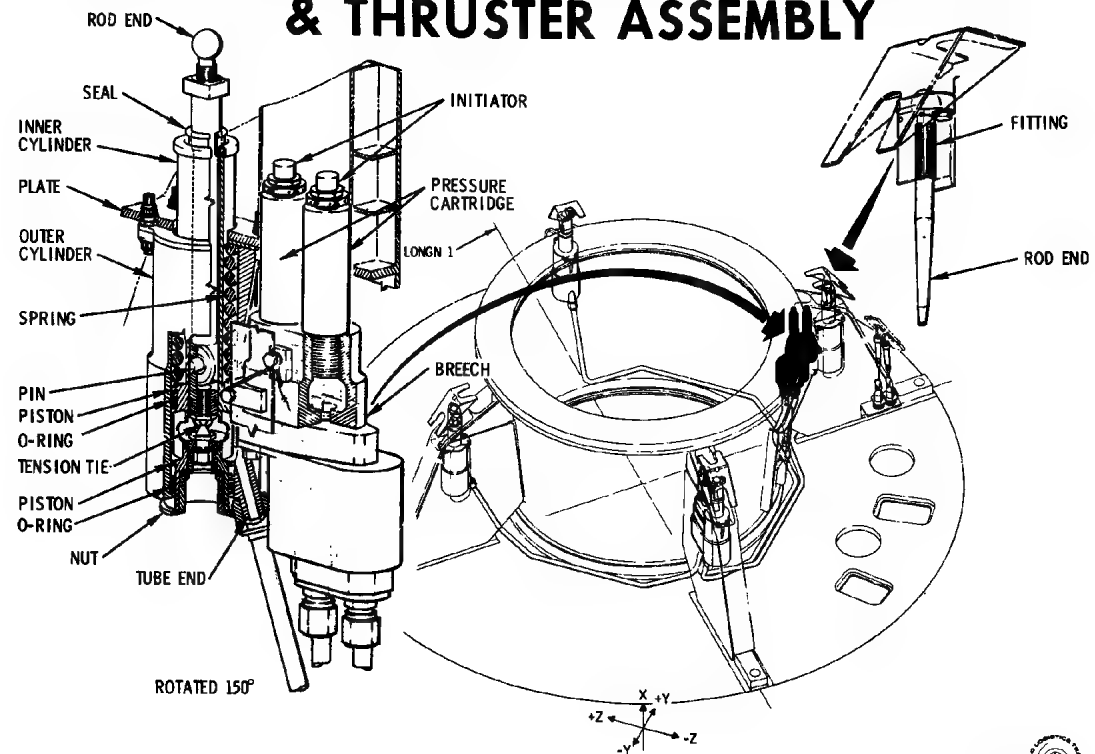


FAM-3009A 

## ELS EQUIPMENT ( BLOCK II )

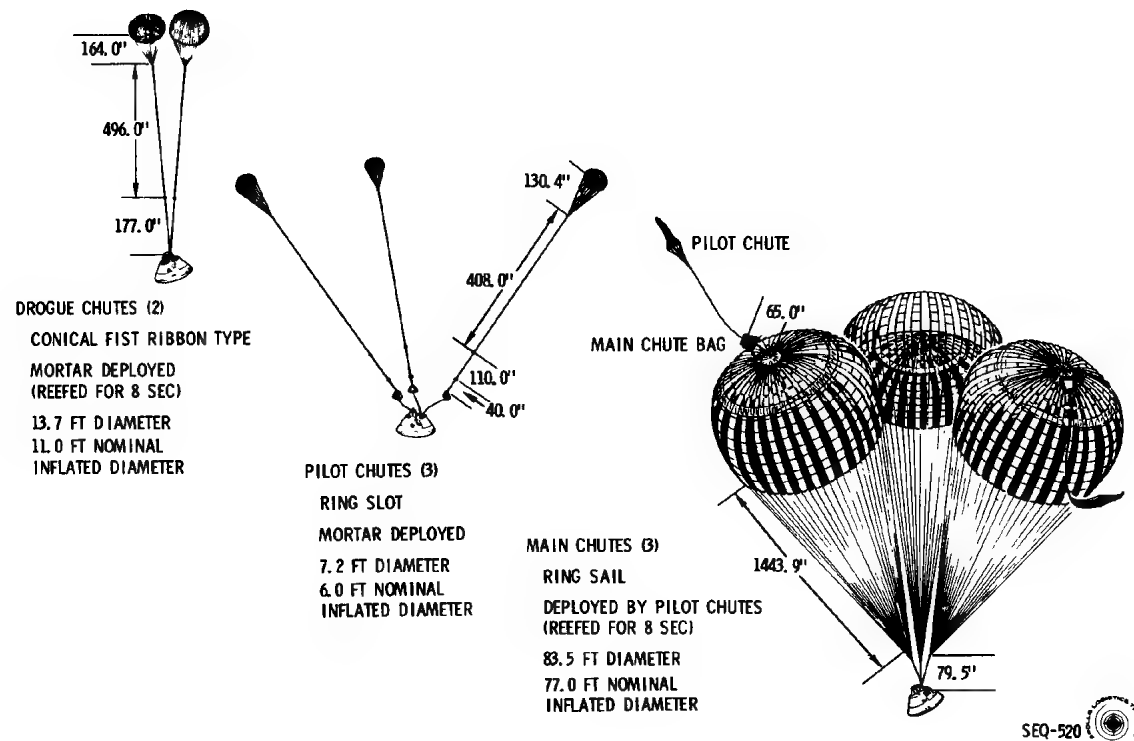


# FORWARD HEATSHIELD ATTACHMENT & THRUSTER ASSEMBLY

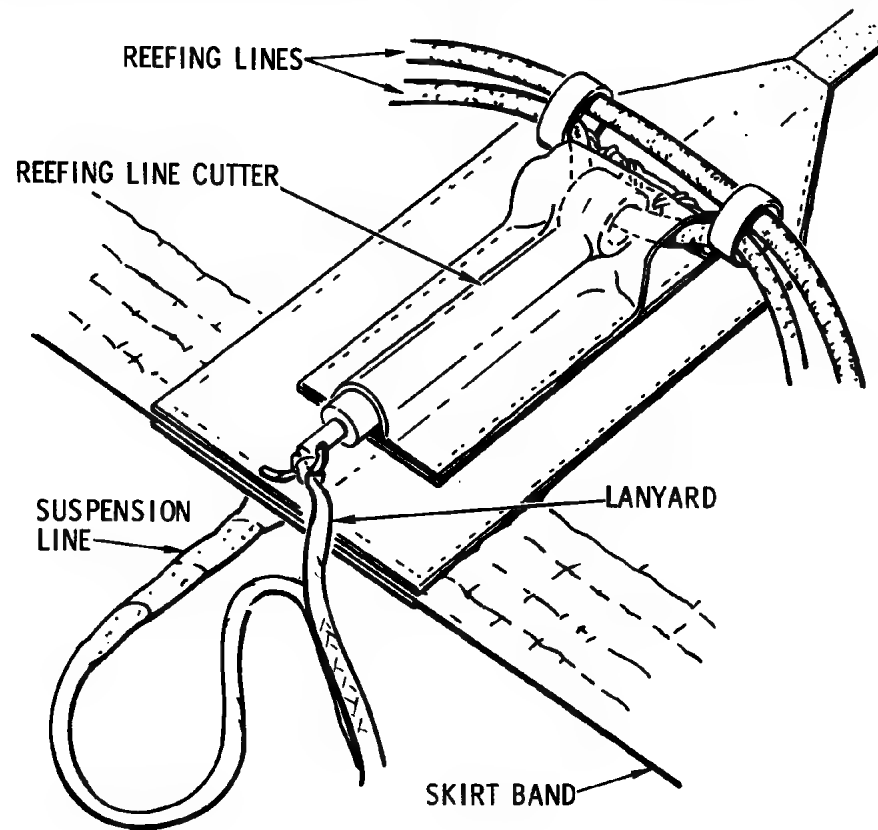



ST-590A

# EARTH LANDING SYSTEM PARACHUTES



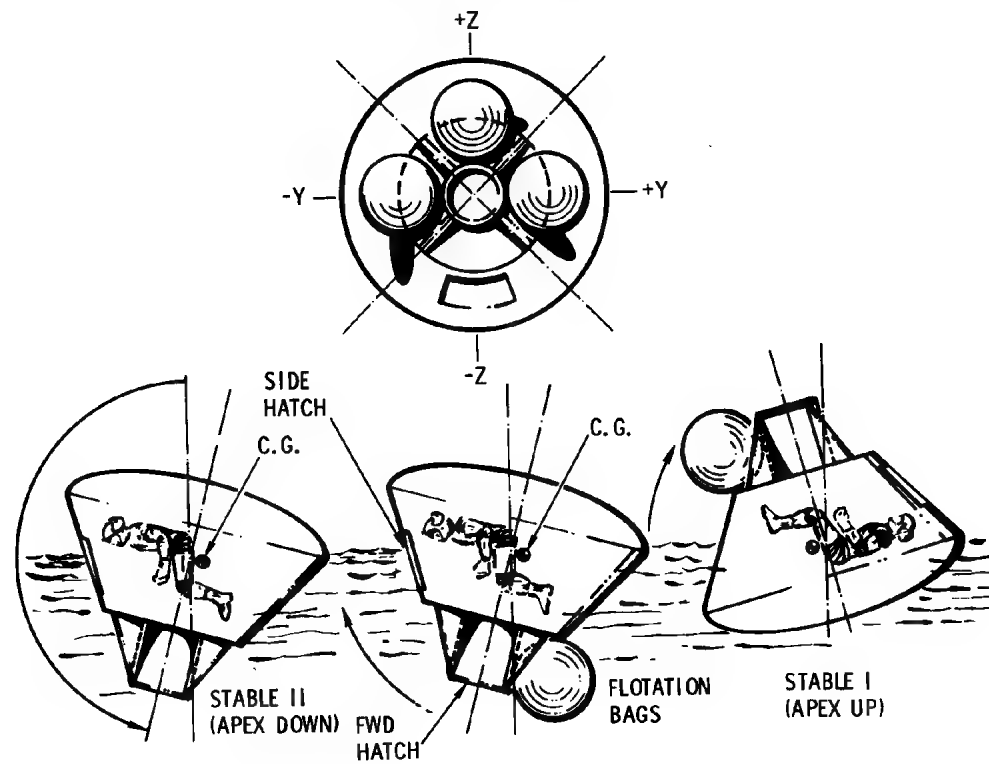
## REEFING LINE CUTTER INSTALLATION




SEQ-75 

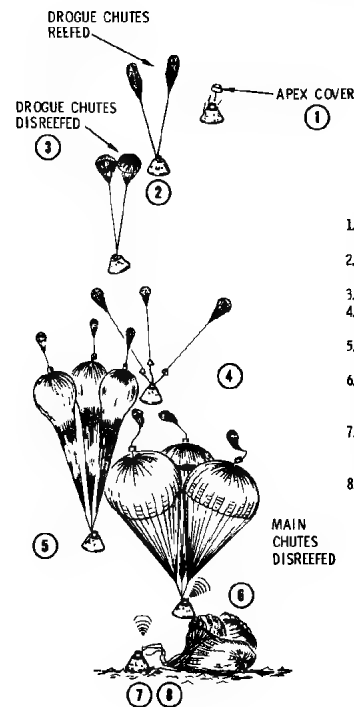
# UPRIGHTING SYSTEM

## 3 BAG SYSTEM



ST-650C 

## EARTH LANDING SYSTEM NORMAL SEQUENCE



1. APEX COVER JETTISONED AT 24,000 FT  
+ .4 SEC (TLM)
2. DROGUE CHUTES DEPLOYED AT 24,000 FT  
+ 2 SEC (REEFED FOR 8 SEC) (TLM)
3. DROGUE CHUTES DISREEFED
4. PILOT CHUTES DEPLOYED & DROGUE  
CHUTES RELEASED AT 10,000 FT (TLM)
5. MAIN CHUTES DEPLOYED AT 10,000 FT  
(REEFED FOR 8 SEC)
6. MAIN CHUTES DISREEFED, VHF  
RECOVERY ANTENNAS, & FLASHING  
BEACON DEPLOYED
7. MAIN CHUTES RELEASED & LM PRESS.  
PYRO VALVE CLOSED AFTER TOUCH-  
DOWN (TLM)
8. HF ANTENNA DEPLOYED (TLM)

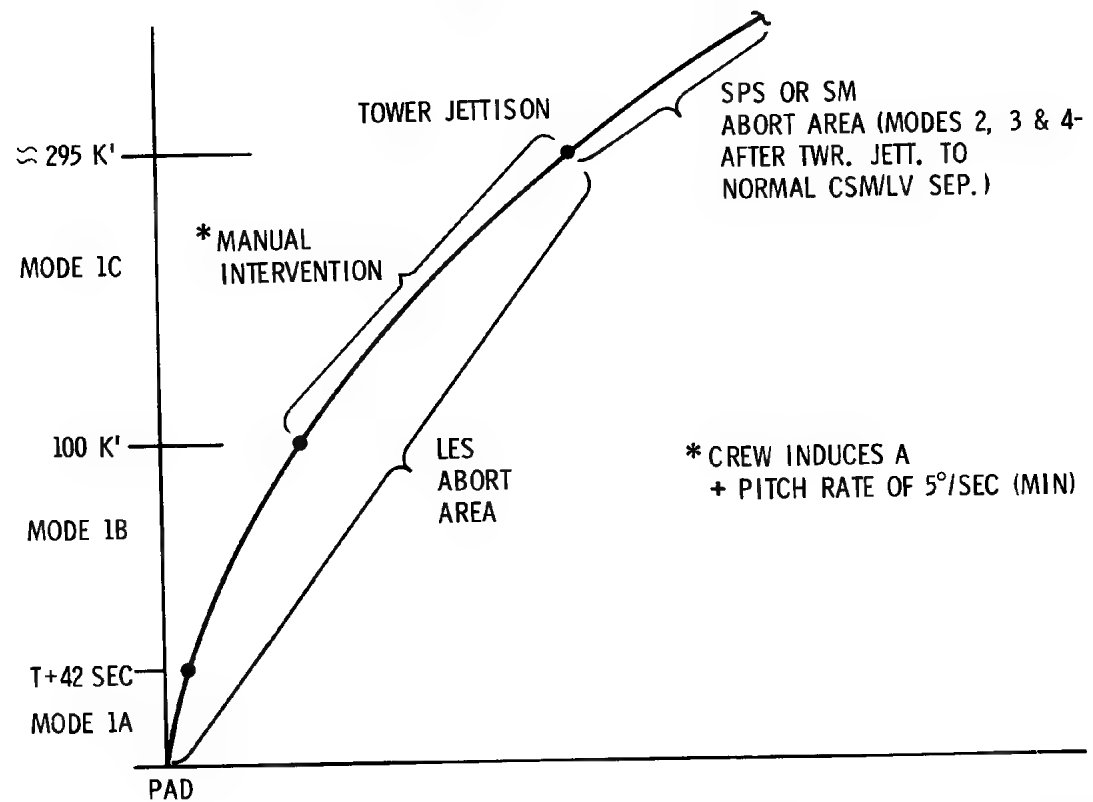
TOUCHDOWN VELOCITIES:  
3 CHUTES - 30.5 FT/SEC

SEQ-547A

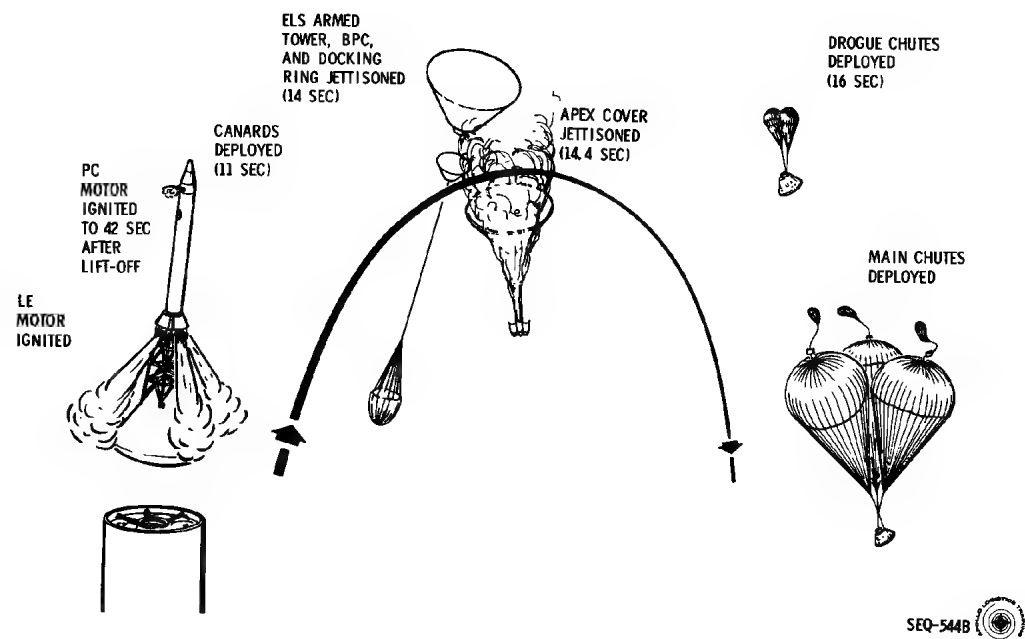




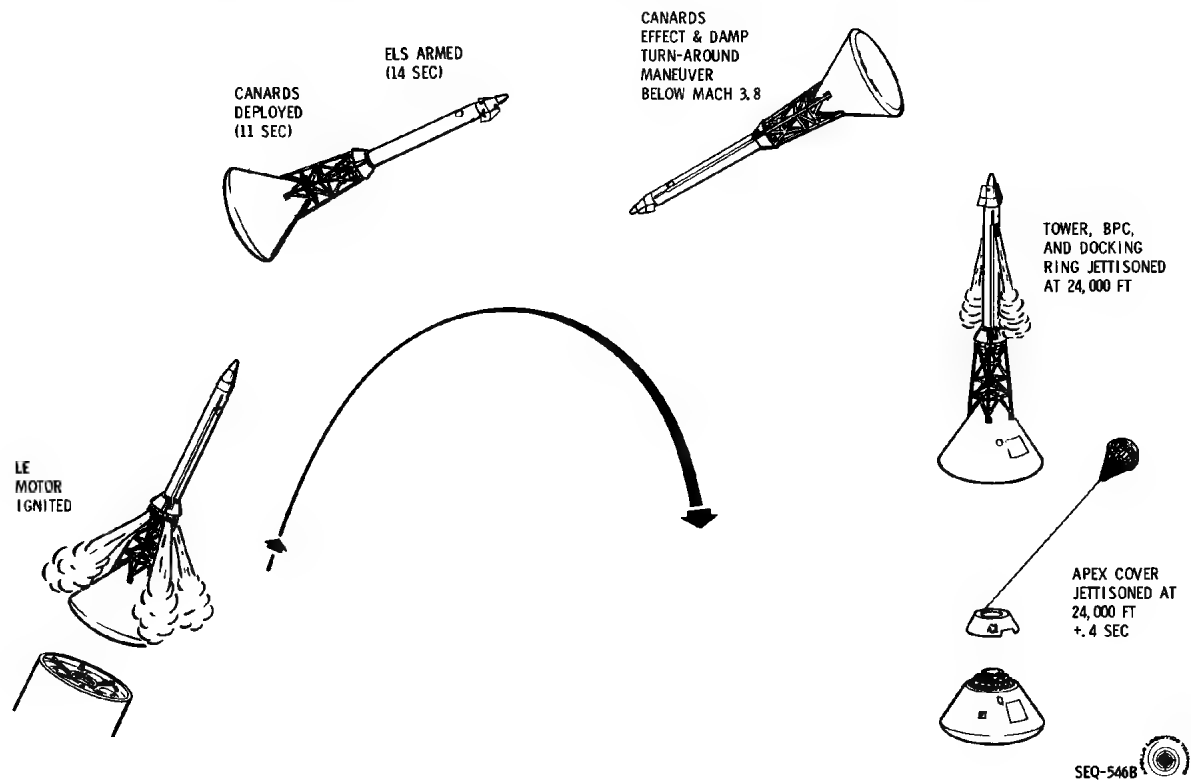
# ABORT DESIGNATIONS BLOCK II - MODE 1



## PAD TO $\approx 30,000$ FT LES ABORT



## ≈ 30,000 FT TO TWR JETT LES ABORT

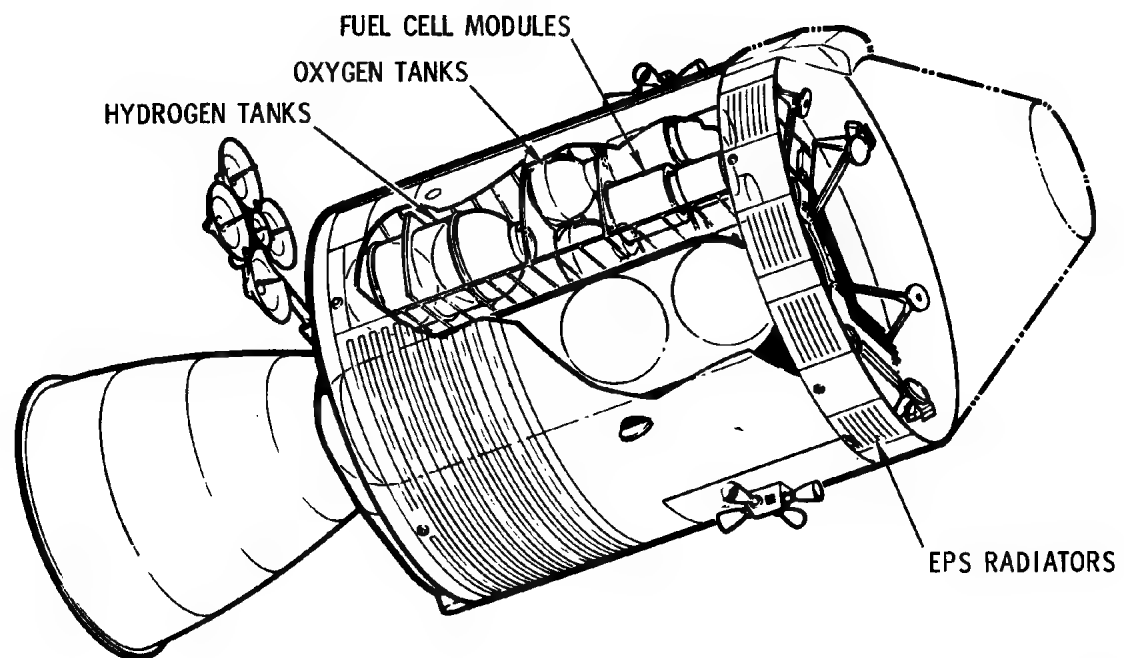


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# ELECTRICAL POWER

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## ELECTRICAL POWER SYSTEM BLOCK II



# **ELECTRICAL POWER SYSTEM**

## **FUNCTIONAL DIVISION**

### **POWER SOURCES**

- **D.C. SYSTEM**
  - FUEL CELL MODULES (3)**
  - BATTERIES (3)**
- **A.C. SYSTEM**
  - INVERTERS (3)**

### **POWER DISTRIBUTION**

- **D.C. BUSSES**
- **A.C. BUSSES**

### **SPECIAL CIRCUITS**

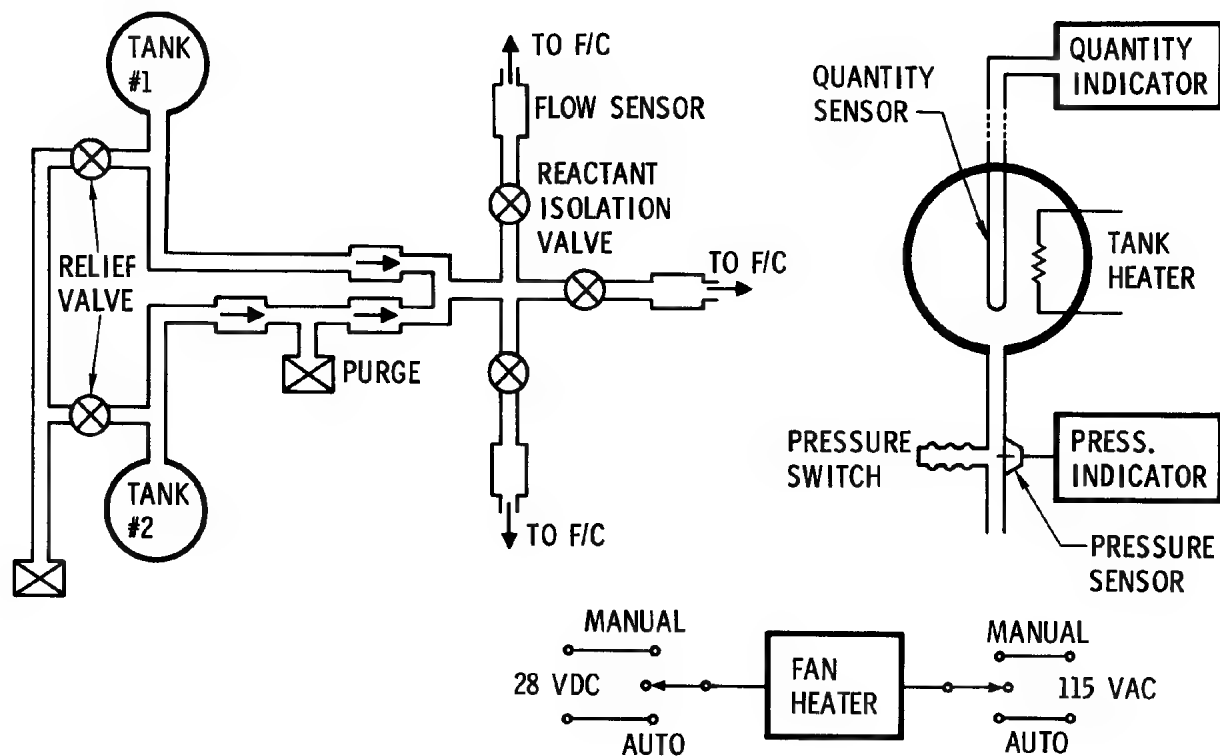
- **BATTERY CHARGER**
- **PYROTECHNIC BATTERIES (2)**
- **S/M JETTISON CONTROL**

## CRYOGENIC STORAGE SYSTEM

GAS	CONTAINER	USEABLE	TOTAL USEABLE
O <sub>2</sub>	INCONEL (2)	320 LBS (EA)	640 LBS
H <sub>2</sub>	TITANIUM (2)	28 LBS (EA)	56 LBS

GAS	INPUT TEMP.	SETTLED TEMP.	STORED PRESSURE	SYSTEM ALLOCATION
O <sub>2</sub>	-297° F	-284° F	900 ± 35 PSIA	EPS - 410 #
				ECS - 230 #
H <sub>2</sub>	-423° F	-417° F	245 ± 15 PSIA	FUEL CELLS ONLY

# CRYOGENIC STORAGE SYSTEM

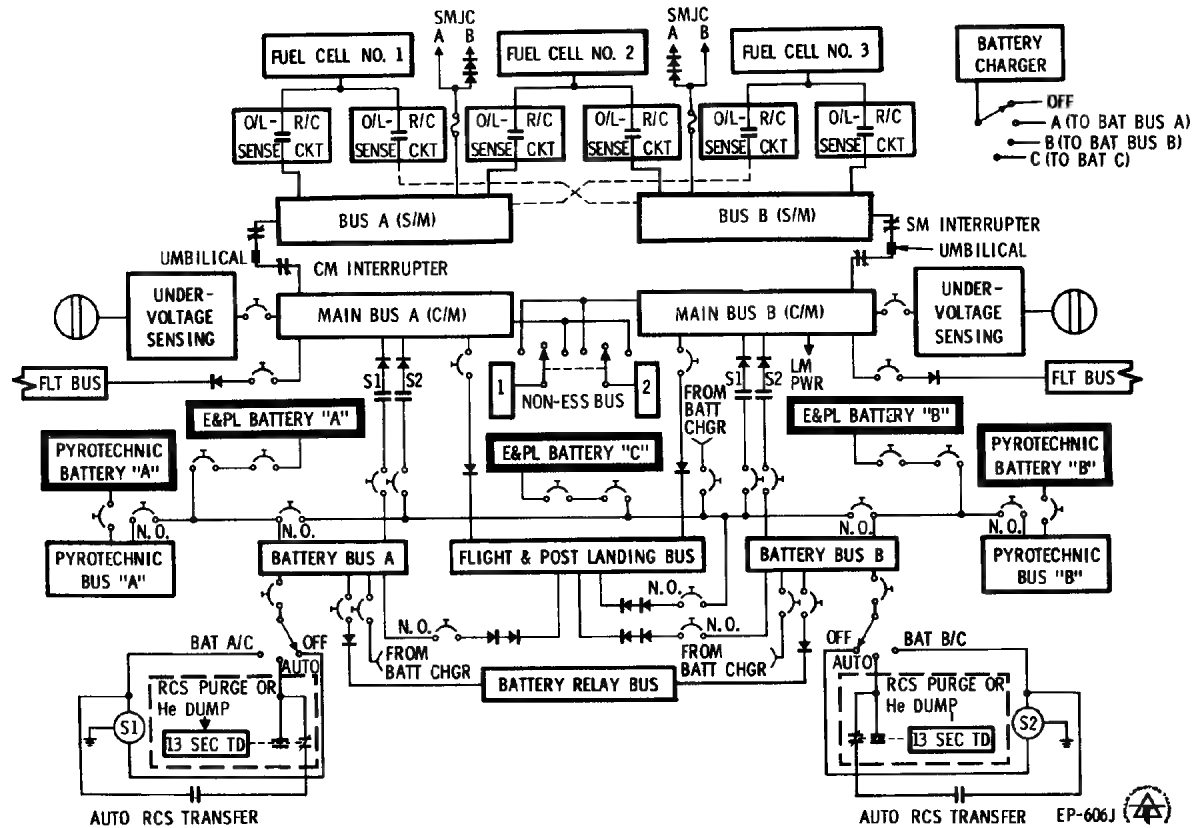


EP-008B 



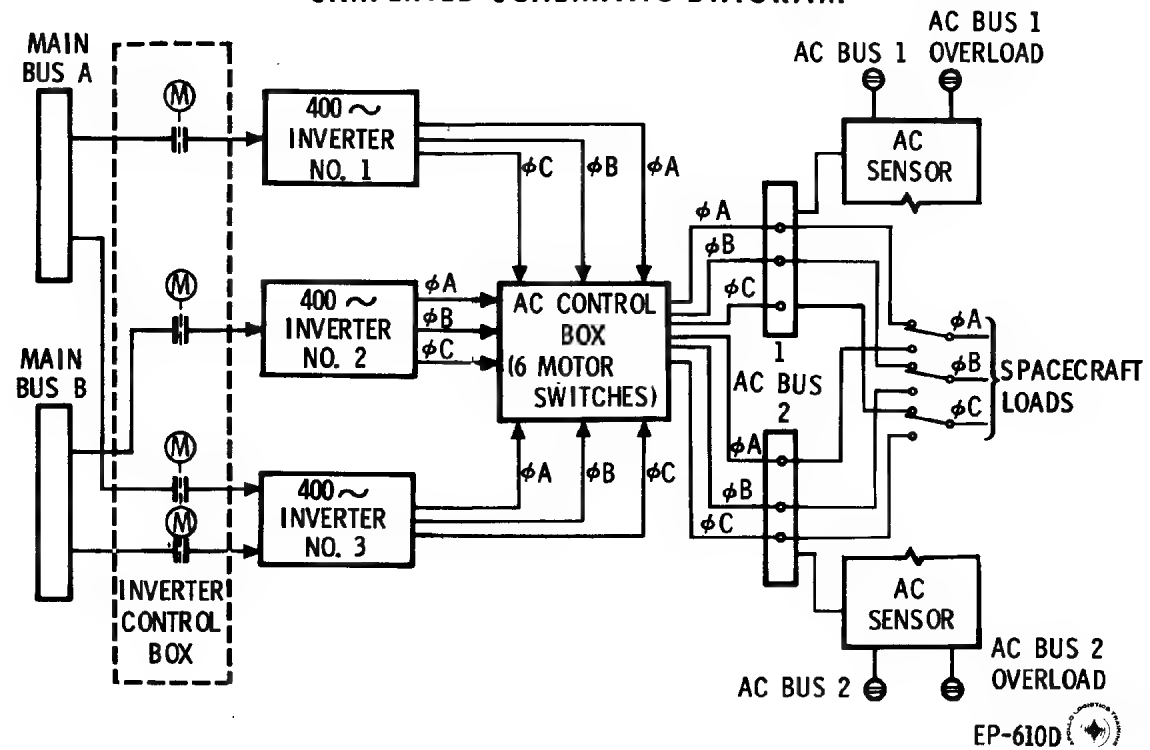
# DC POWER DISTRIBUTION

## SIMPLIFIED SCHEMATIC DIAGRAM

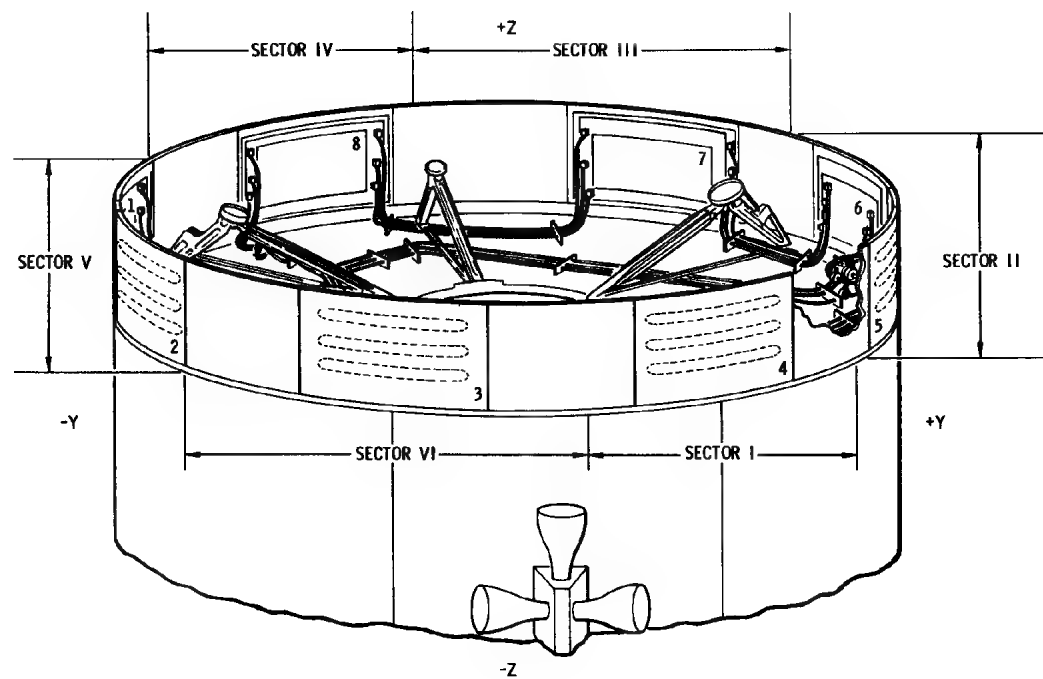


# AC POWER DISTRIBUTION

## SIMPLIFIED SCHEMATIC DIAGRAM

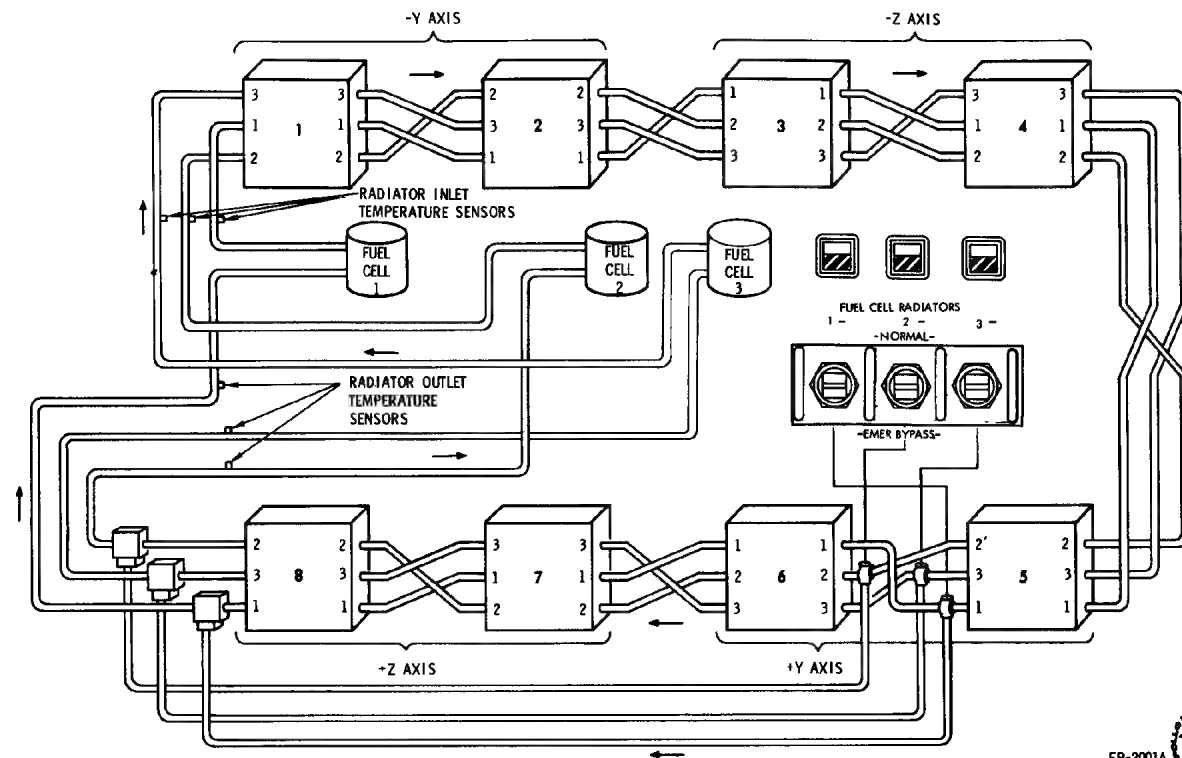


## EPS RADIATOR LOCATION BLOCK II



# EPS RADIATOR CONTROL

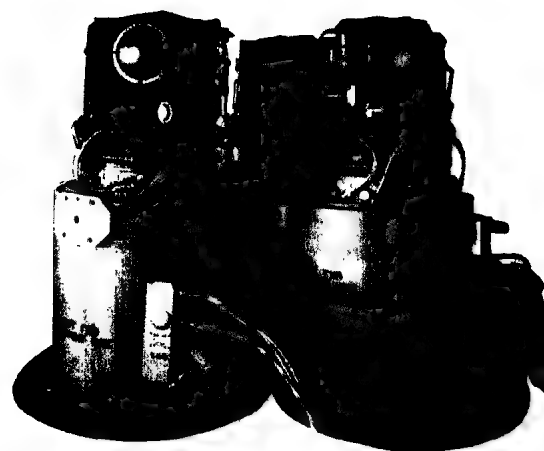
## BLOCK II



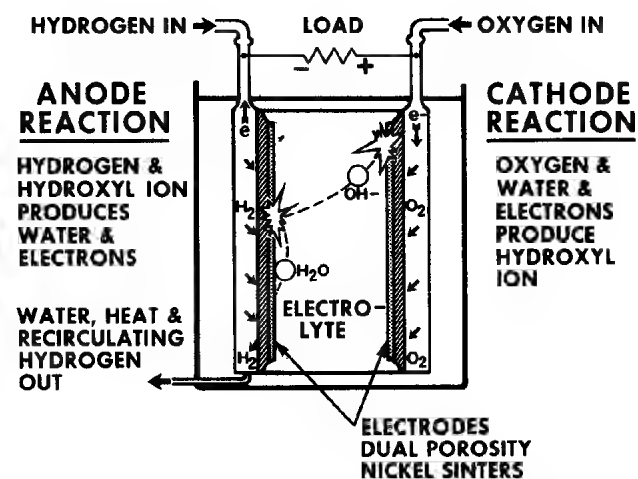
EP-2001A



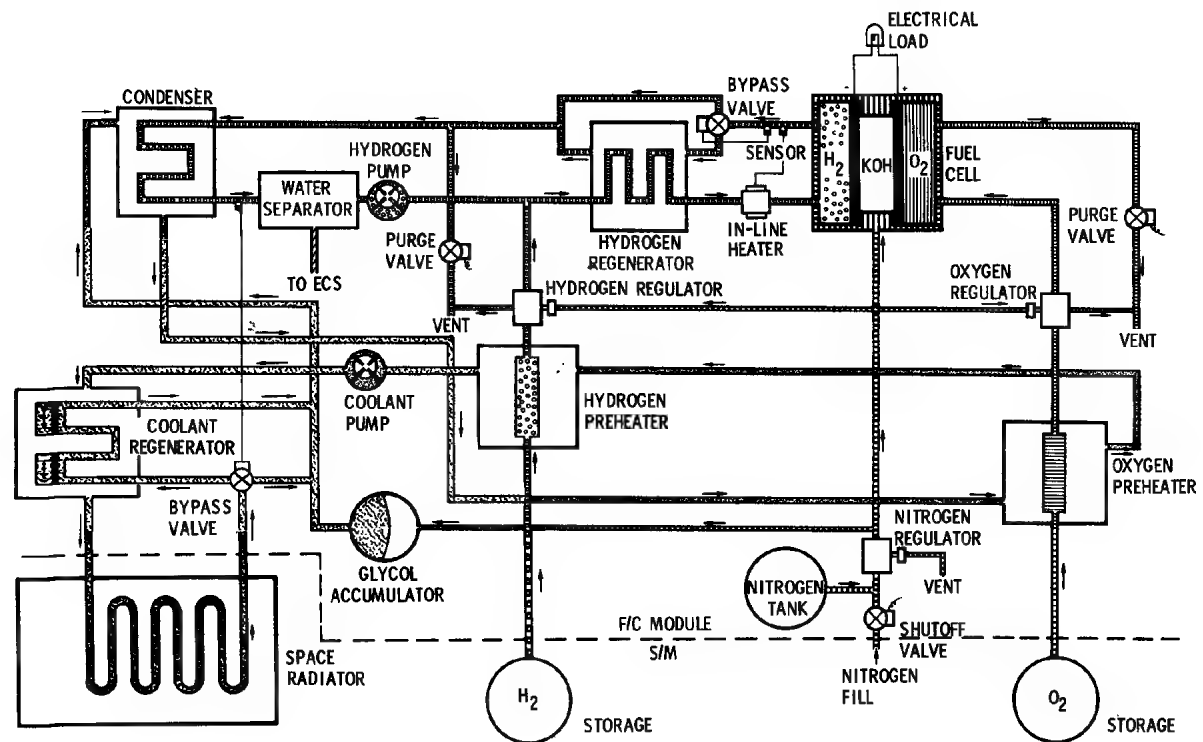
## APOLLO FUEL CELL POWERPLANT



HEIGHT = 44 IN.  
DIAM = 22 IN.  
WEIGHT = 245 LB EACH

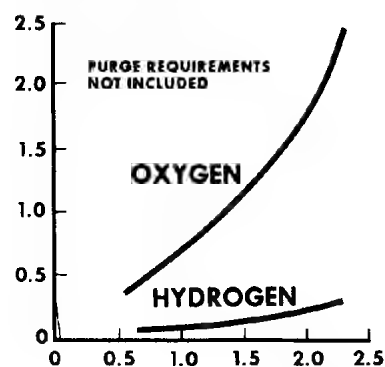


# EPS FUEL CELL DIAGRAM

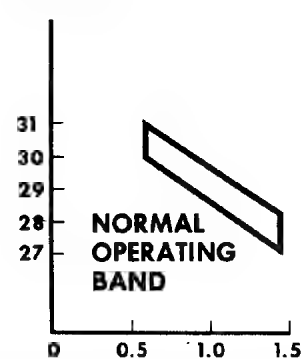


## FUEL CELL REACTION

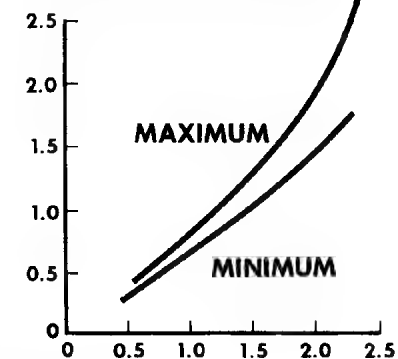
MAXIMUM REACTANT  
CONSUMPTION-  
POUNDS PER HOUR



VOLTAGE

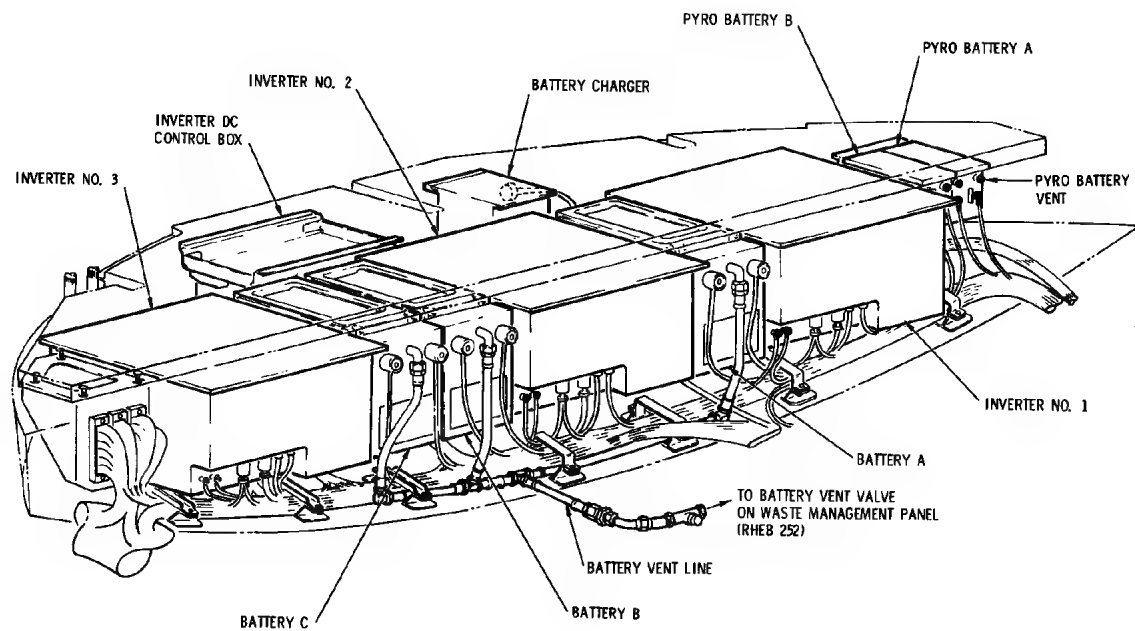


WATER GENERATION RATE-  
POUNDS PER HOUR-  
PURGING NOT INCLUDED



GROSS POWER PER POWERPLANT - KILOWATTS

## EPS COMPONENTS LOWER EQUIPMENT BAY (BLOCK II)





# ENVIRONMENTAL CONTROL

FAM-2505A 

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# **ECS FUNCTIONAL REQUIREMENTS**

## **CONTROL SPACECRAFT ATMOSPHERE**

- PRESSURE-TEMPERATURE-HUMIDITY-CONTAMINATION

## **PROVIDE COOLING FOR SPACECRAFT EQUIPMENT**

- GUIDANCE & NAVIGATION-STABILIZATION & CONTROL
- COMMUNICATIONS-AC POWER SUPPLY-OTHER

## **CONTROL COLLECTION, STORAGE & DISTRIBUTION OF WATER**

- POTABLE WATER FOR CREW USE
- WASTE WATER FOR SUPPLEMENTAL COOLING

# ENVIRONMENTAL CONTROL

## SUBSYSTEM FUNCTIONS

### OXYGEN SUPPLY SUBSYSTEM

- NORMAL OXYGEN SUPPLY
- ENTRY OXYGEN SUPPLY
- CABIN PRESSURE CONTROL
- FLUID TANK PRESSURIZATION

### PRESSURE SUIT SUBSYSTEM

- WATER & CONTAMINANT REMOVAL FROM SUIT & CABIN
- SUIT PRESSURE & TEMPERATURE CONTROL

### WATER SUBSYSTEM

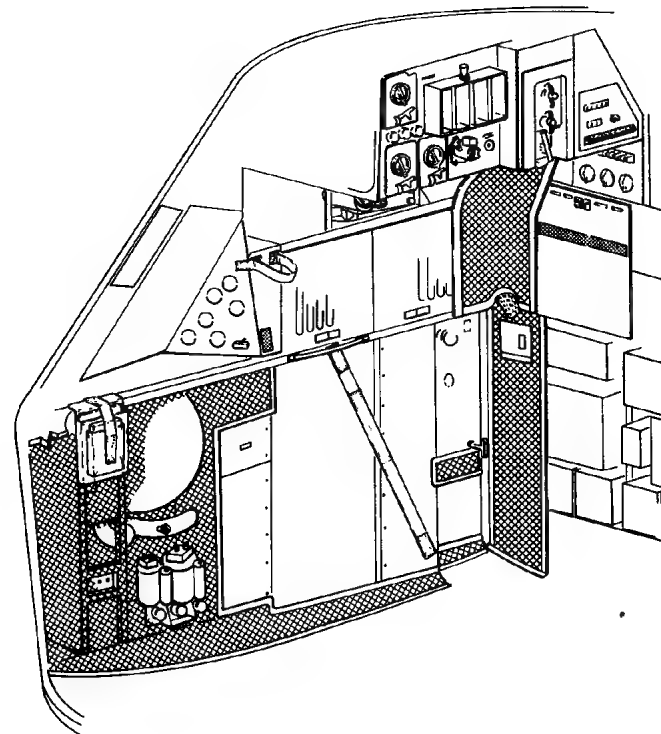
- STORES & DISTRIBUTES
  - POTABLE WATER (DRINKING & FOOD RECONSTITUTION)
  - WASTE WATER (SUPPLEMENTAL COOLING)

### WATER GLYCOL SUBSYSTEM

- PRIMARY HEAT TRANSFER
- COOLING FOR SUIT & ELECTRONICS
- HEATING OR COOLING FOR CABIN
- REJECTS EXCESS HEAT TO SPACE


# APOLLO CM INTERIOR LHEB & LHFE

## BLOCK II



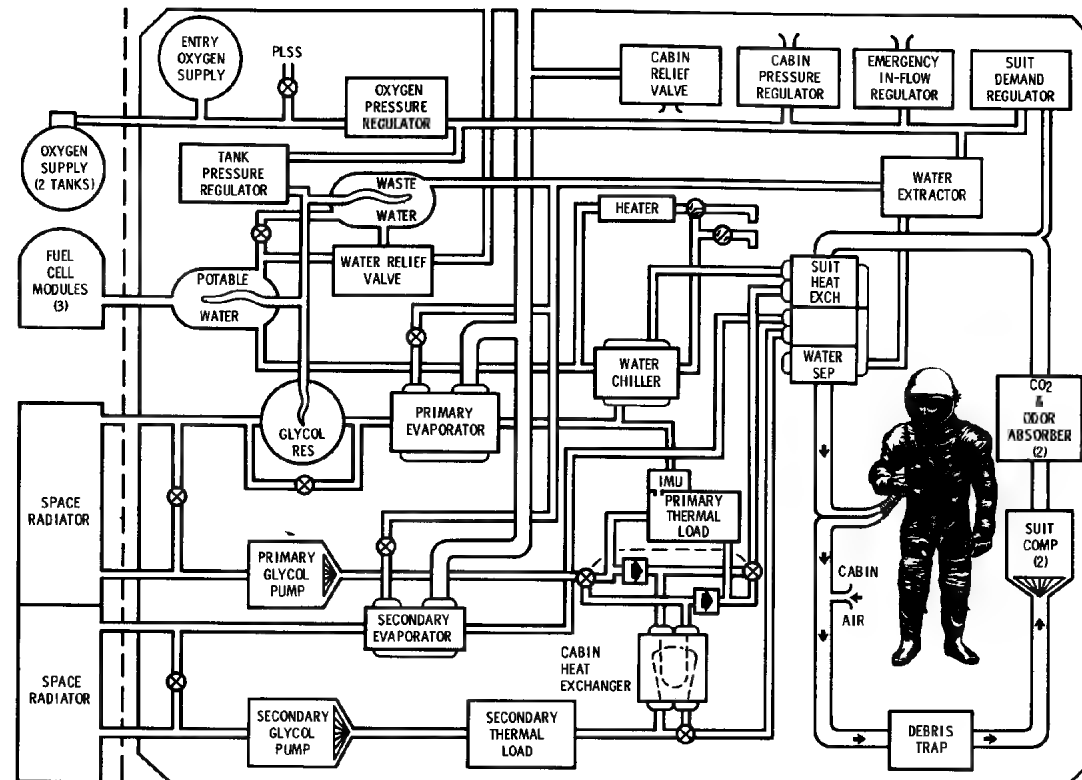
■ VELCRO

FEB 67

CS-0014 

# ENVIRONMENTAL CONTROL

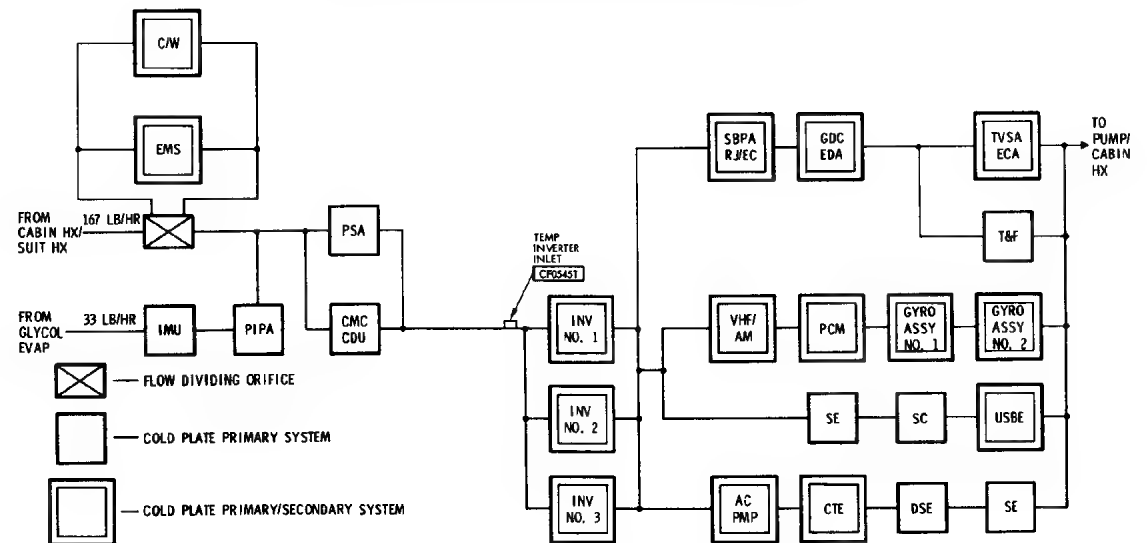
BLOCK II



FAM-2507D


# COLD PLATE NETWORK

PRIMARY SYSTEM - BLOCK II

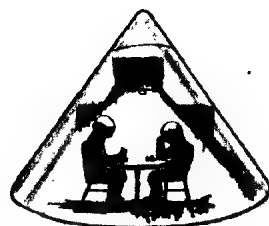


# CREW EQUIPMENT

9

FAM-5015 

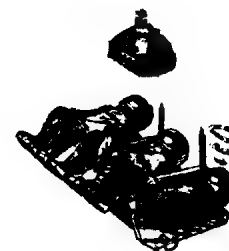
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LIGHT AND SIGHT



SPACE SUIT ASSY



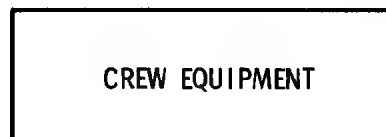
CREW COUCHES



RESTRAINTS



SURVIVAL



CREW EQUIPMENT



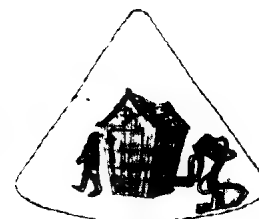
INFLIGHT TOOLSET



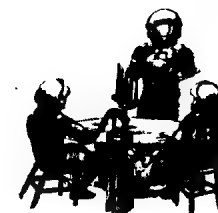
MISSION EXPERIMENTS



MEDICAL



WASTE CONTROL



WATER AND FOOD

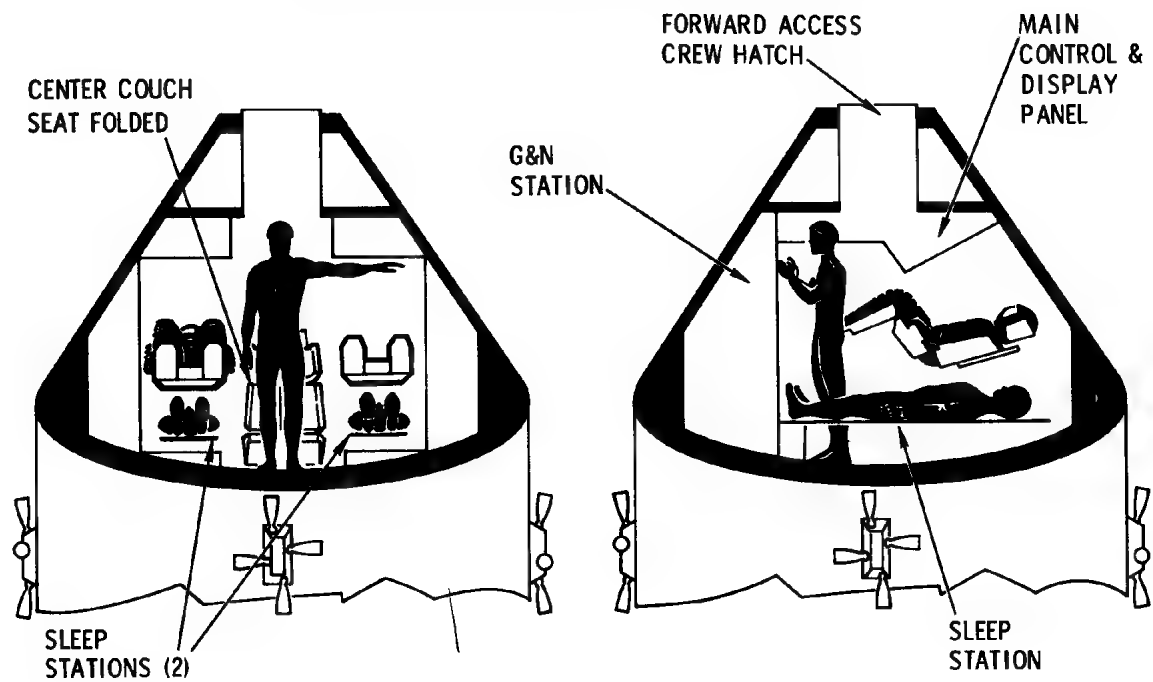
MAR 66

FAM-5402 A



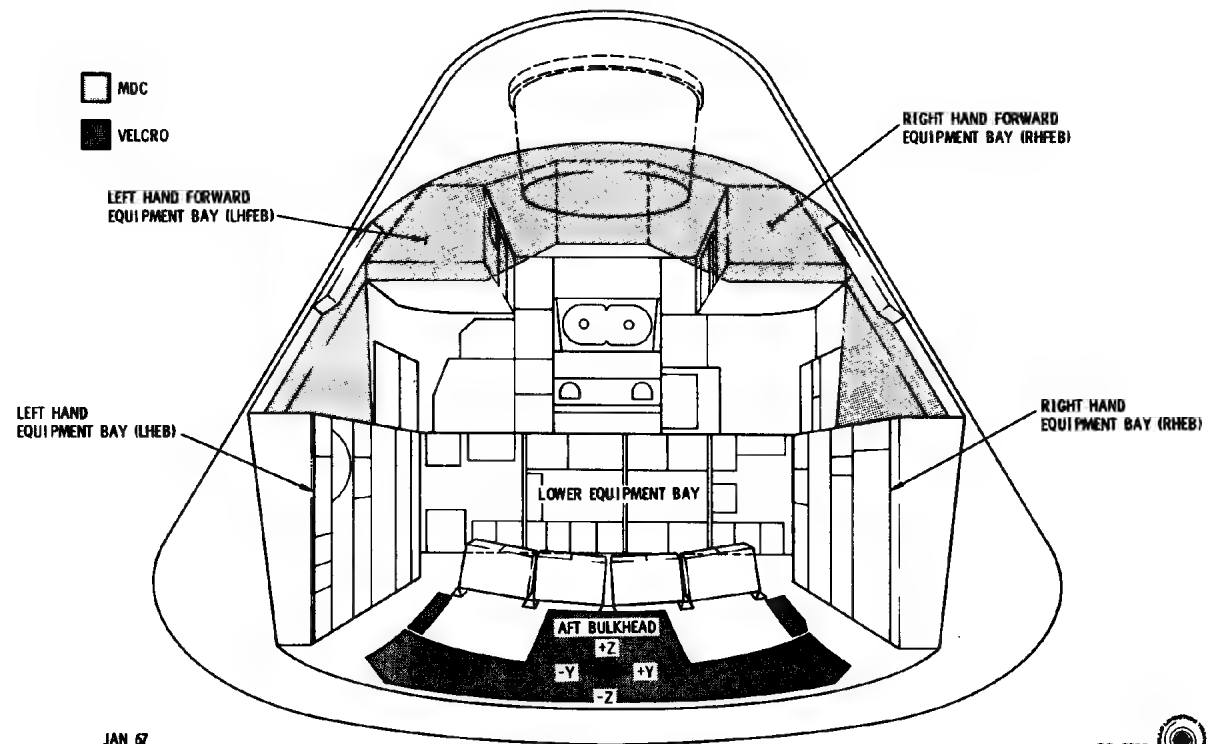


## APOLLO CREW STATIONS



# APOLLO CREW COMPARTMENT

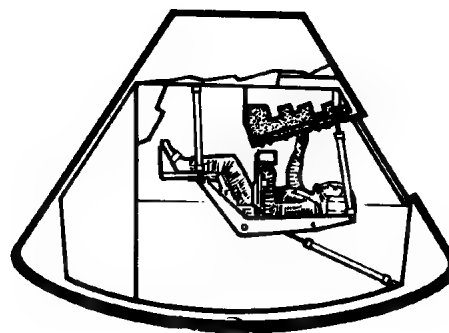
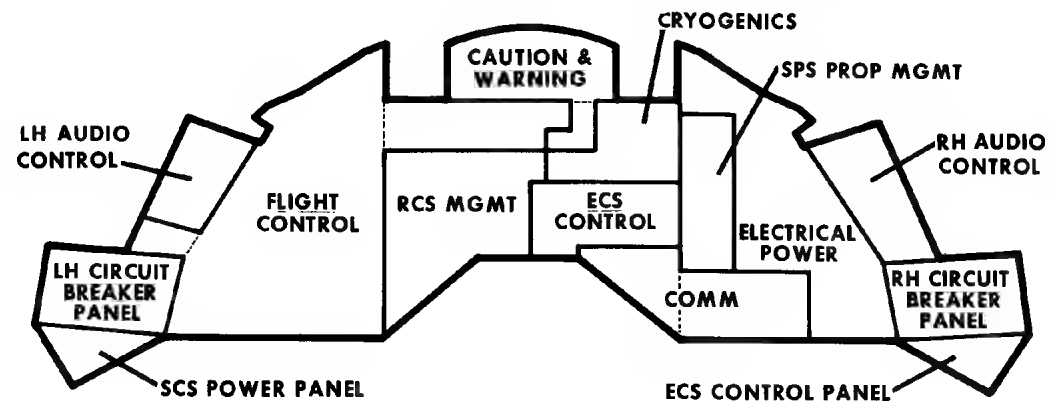
BLOCK II



JAN 67

CS-0012

## COMMAND MODULE MAIN PANEL

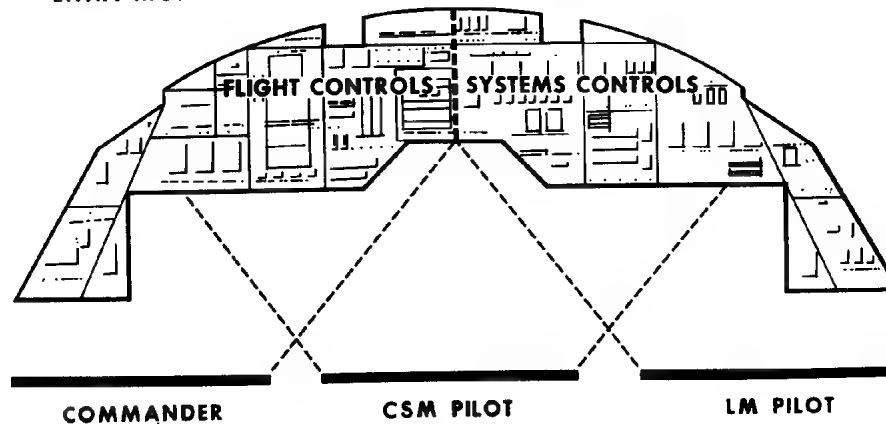


S66SD10818-1B

# MAIN PANEL FUNCTIONS

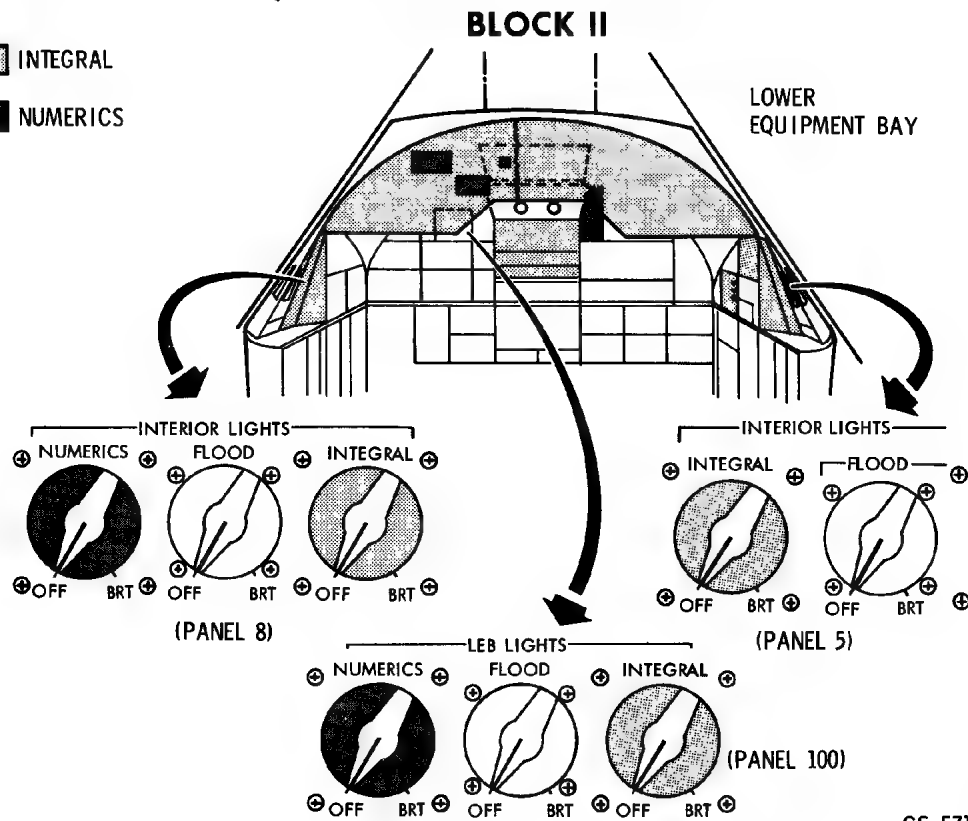
- LV EMERGENCY DETECTION
- FLIGHT ATTITUDE
- MISSION SEQUENCE
- $\Delta V$  MONITOR
- ENTRY MONITOR

- PROPELLANT GAGING
- ENVIRONMENT CONTROL
- COMMUNICATIONS CONTROL
- POWER DISTRIBUTION
- CAUTION & WARNING



# CM INTEGRAL/NUMERICS ILLUMINATION SYSTEM

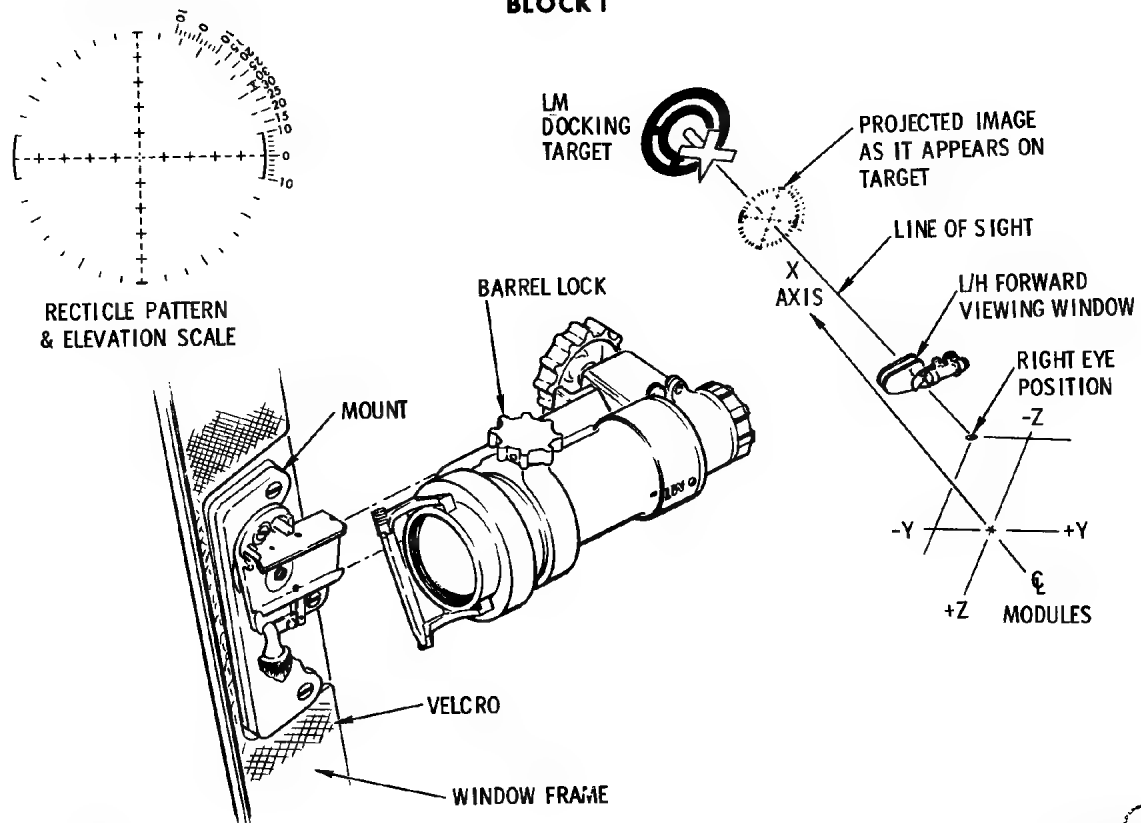
☐ INTEGRAL  
☐ NUMERICS



JAN 67

CS-571A

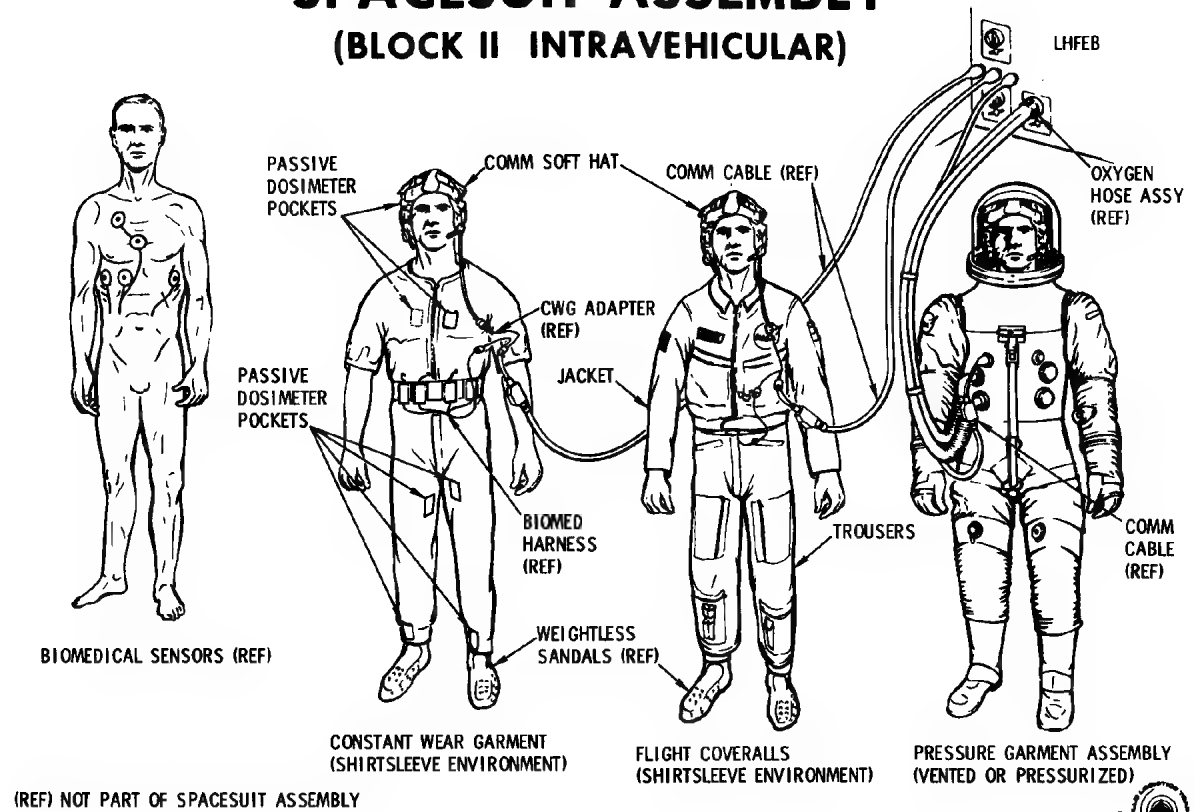
# **APOLLO CREWMAN ALIGNMENT SIGHT SYSTEM CONFIGURATION** **BLOCK I**




FEB 67

CS-531C

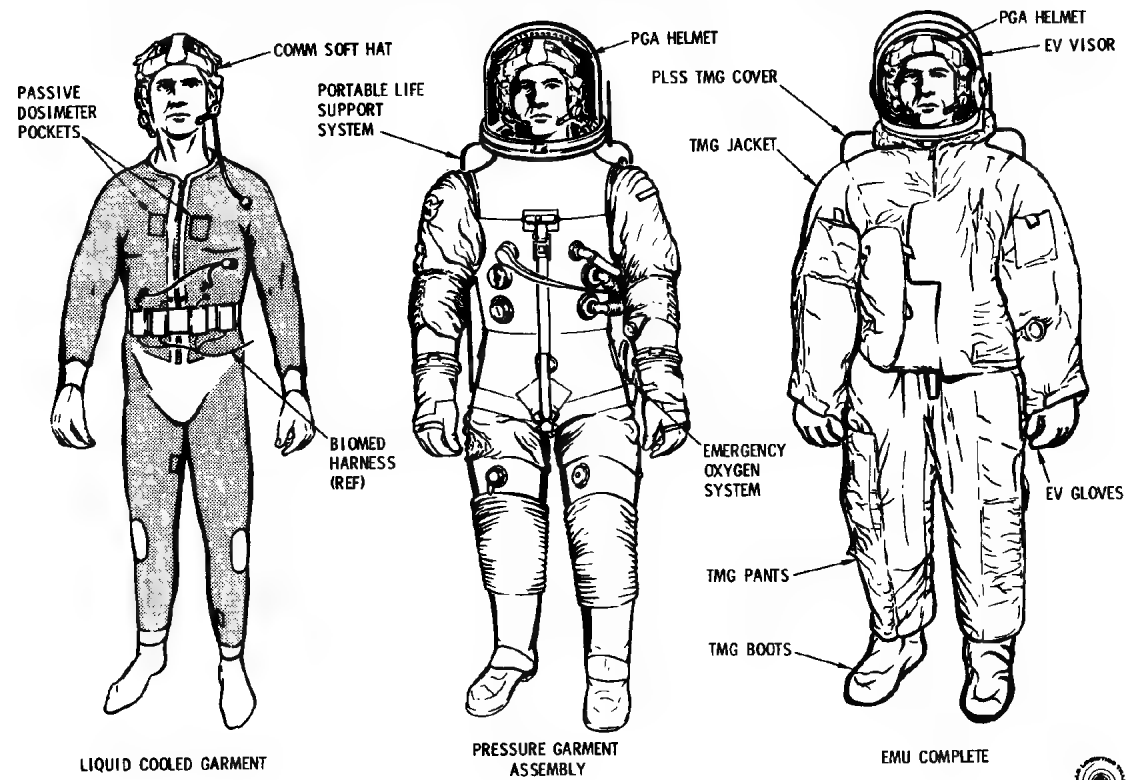
# SPACESUIT ASSEMBLY (BLOCK II INTRAVEHICULAR)



MAY 67

CS-1001 B 

# EXTRAVEHICULAR MOBILITY UNIT (EMU)



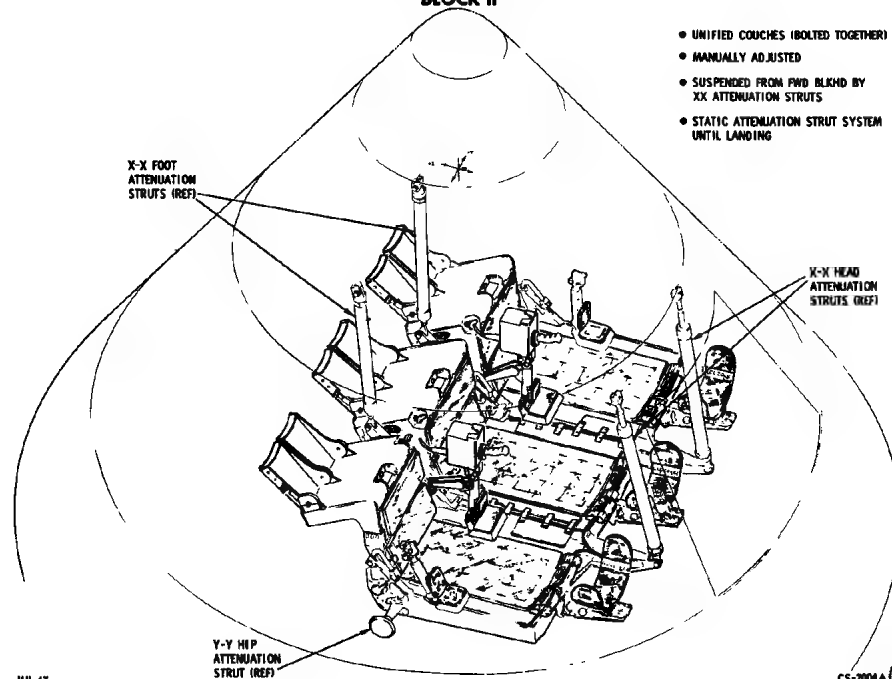
JAN 67

CS-1002A 



## CREW COUCH STRUCTURE BLOCK II

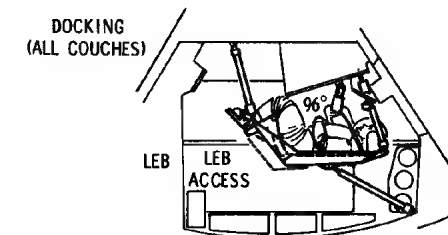
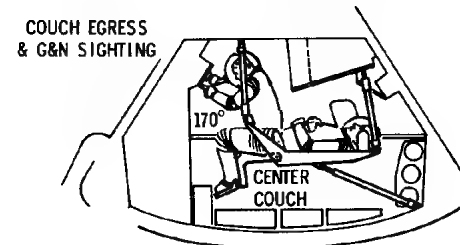
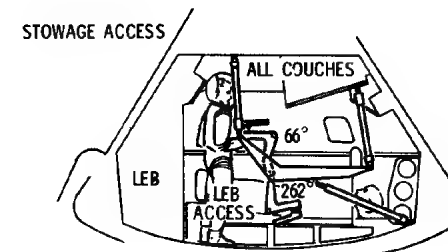
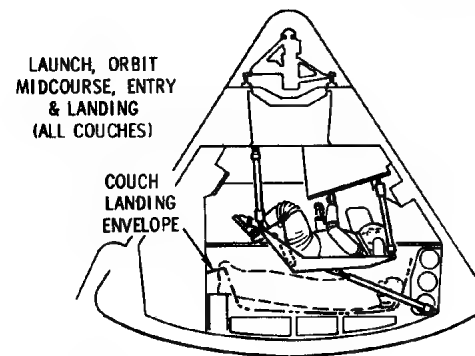
- UNIFIED COUCHES (BOLTED TOGETHER)
- MANUALLY ADJUSTED
- SUSPENDED FROM FWD BLKND BY XX ATTENUATION STRUTS
- STATIC ATTENUATION STRUT SYSTEM UNTIL LANDING



JUL 67

CS-200A

## MISSION PHASES WITH COUCH POSITIONS & SEAT ANGLE SC 2TV-1 & 101

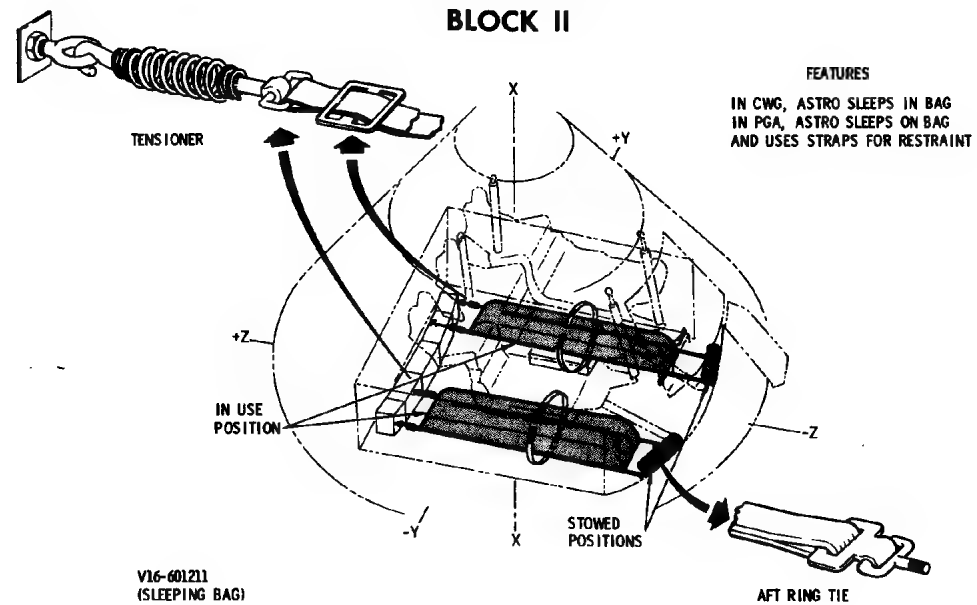


JUN 67

CS-2025C (4)

# SLEEPING POSITION RESTRAINT CONFIGURATION

## BLOCK II



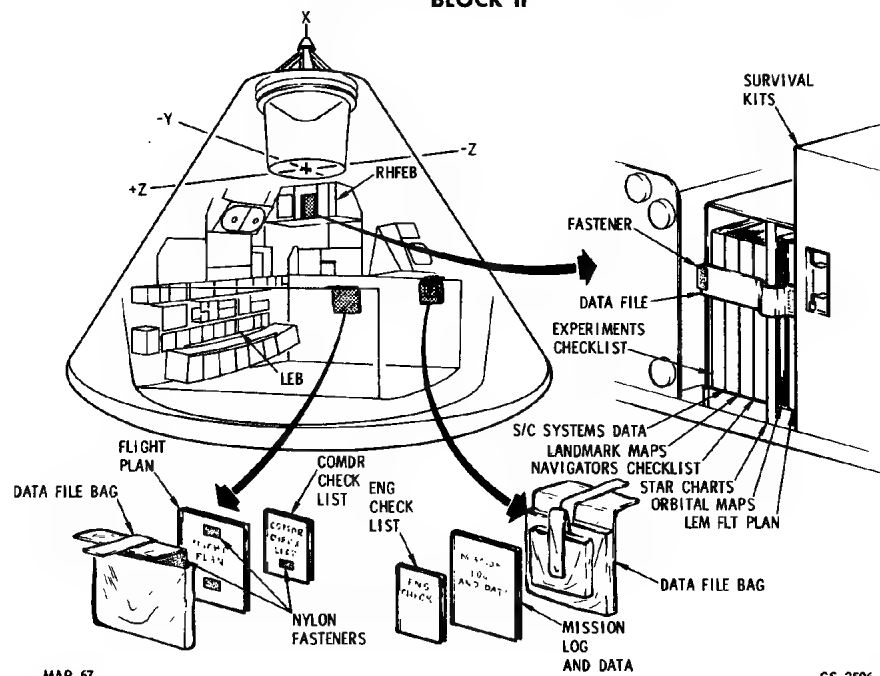
MAR 67

CS-2331



# FLIGHT DATA FILE

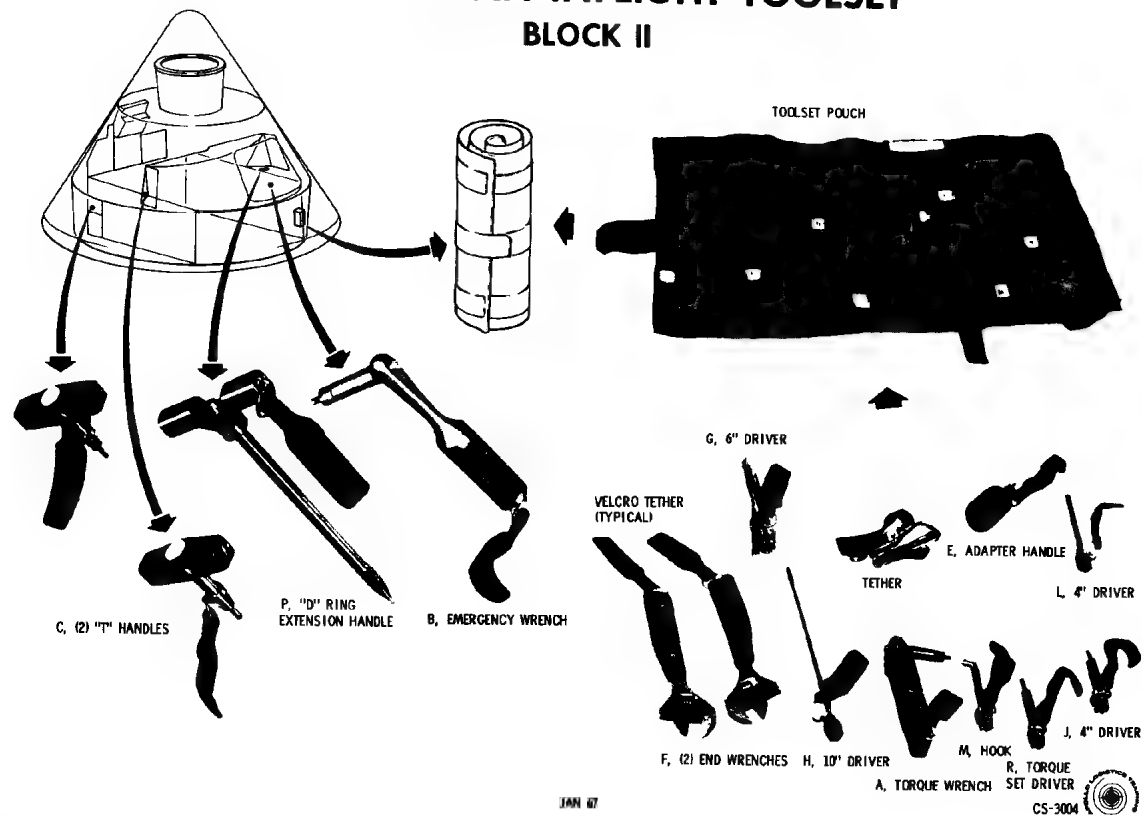
## BLOCK II



MAR 67

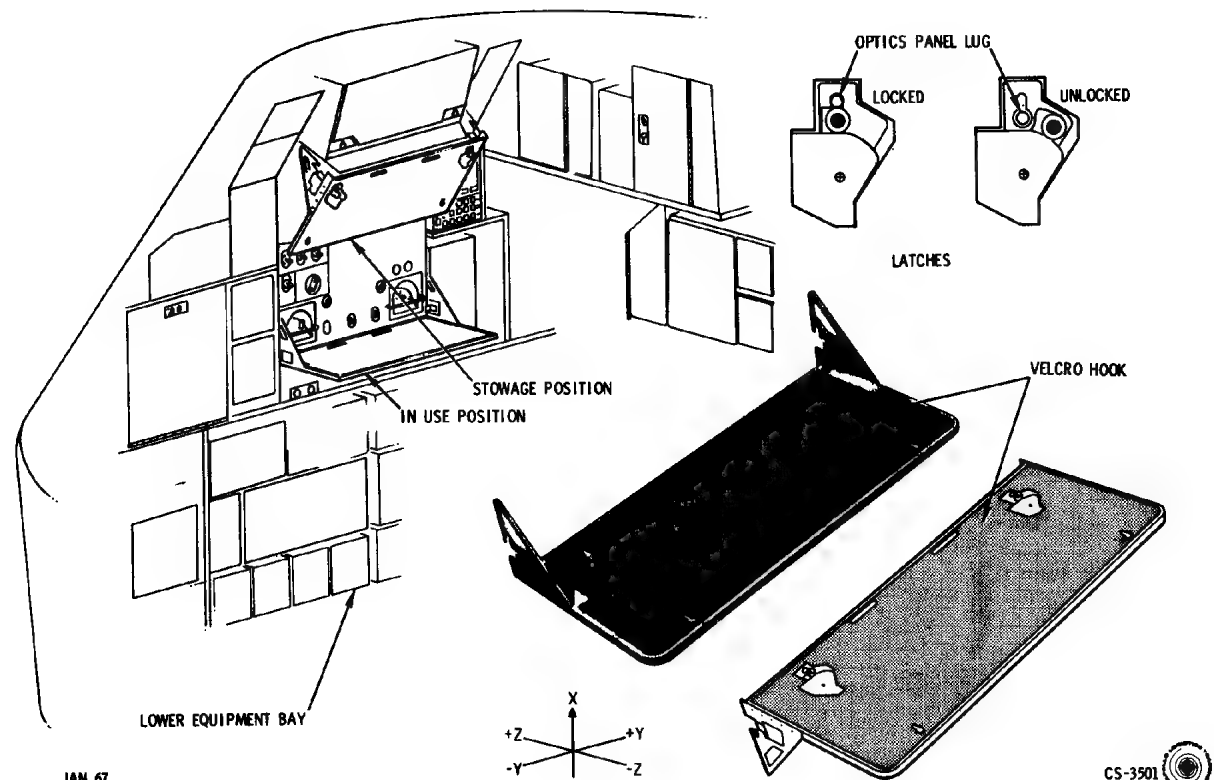
CS-2506

# CM CREWMAN INFLIGHT TOOLSET BLOCK II

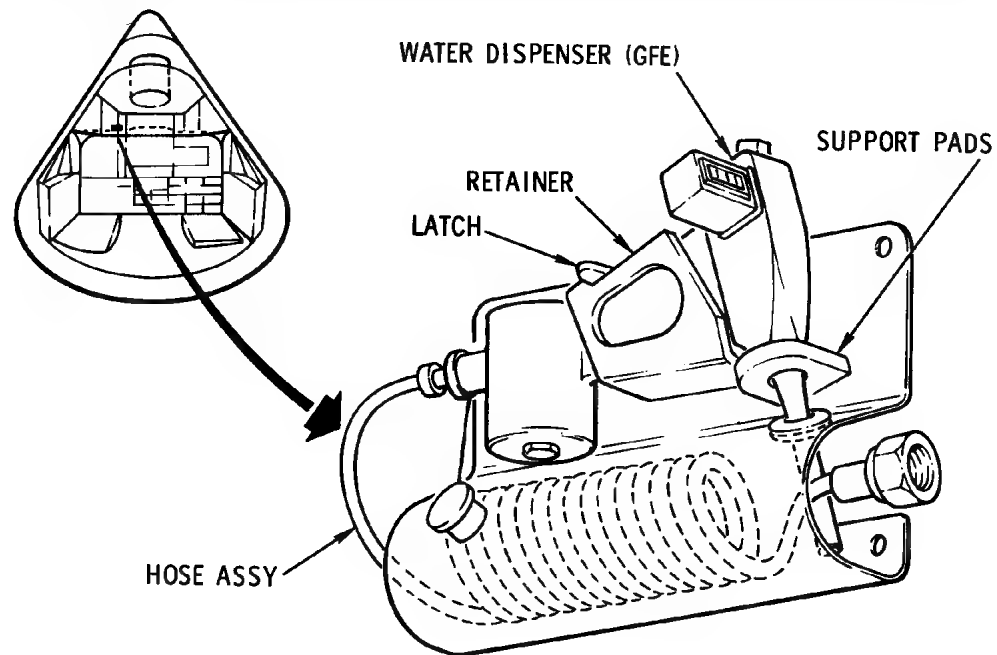


JAN 67

# WORK SHELF/OPTICS PANEL COVER BLOCK II



## WATER METERING DISPENSER ASSEMBLY

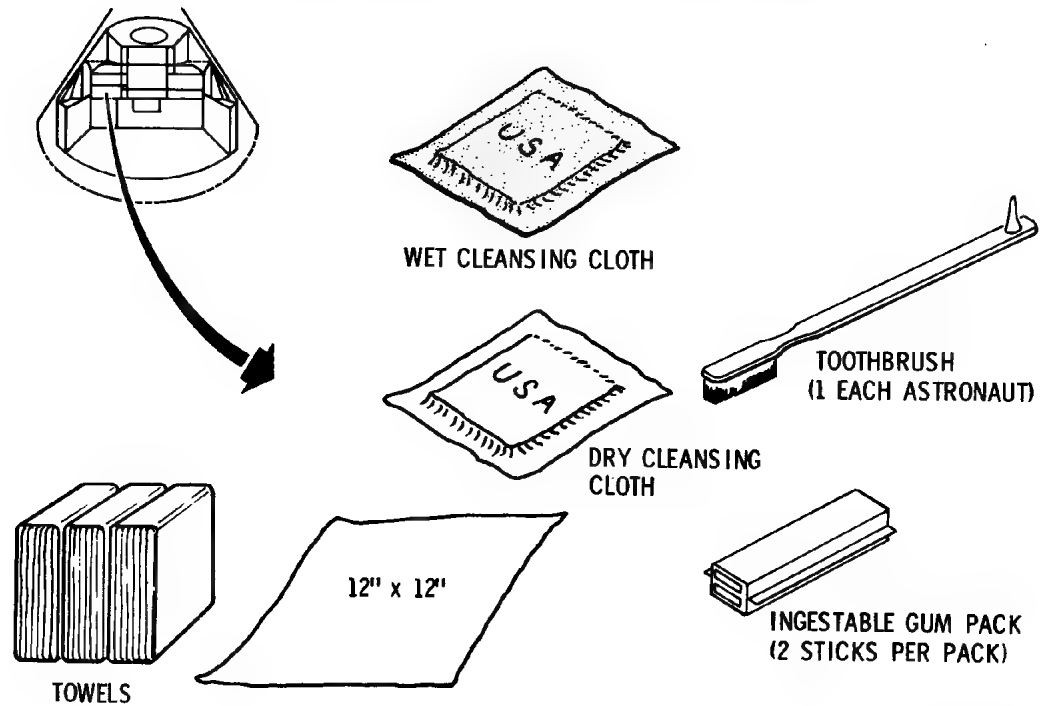



JAN 67

CS-4101D 



## PERSONAL HYGIENE ITEMS



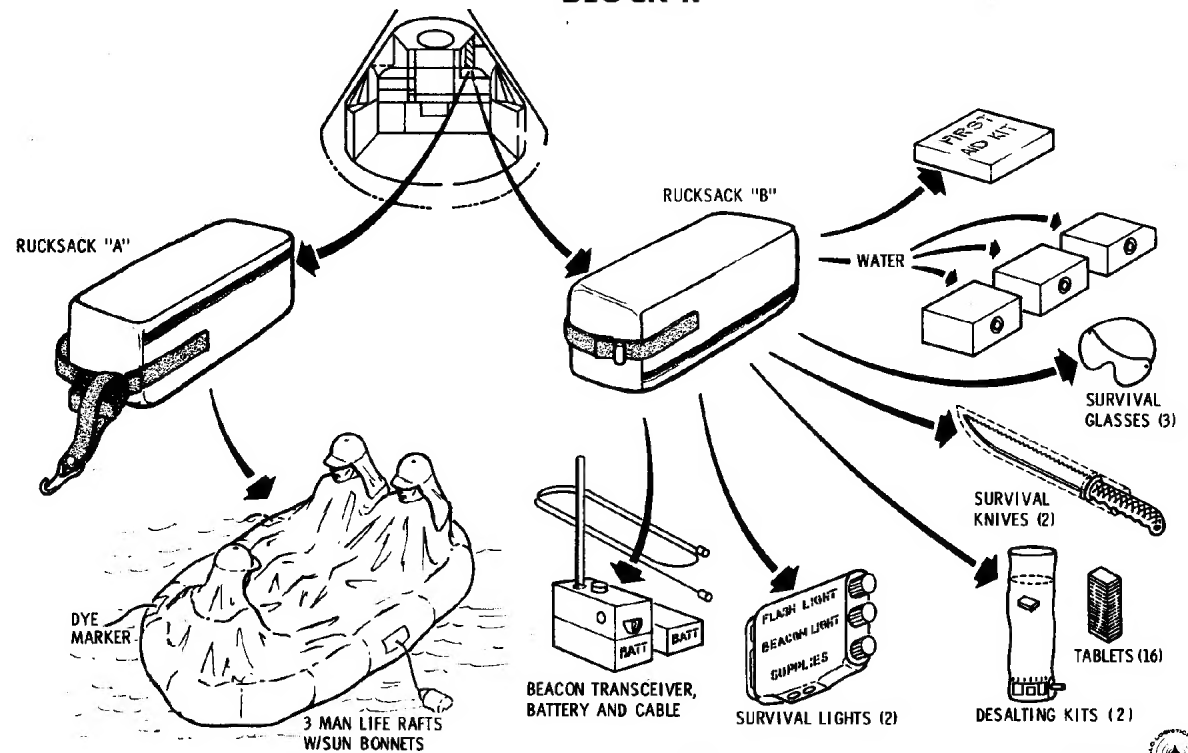
CS-5501D 

## BLOCK II



# APOLLO SURVIVAL KIT AND COMPONENTS

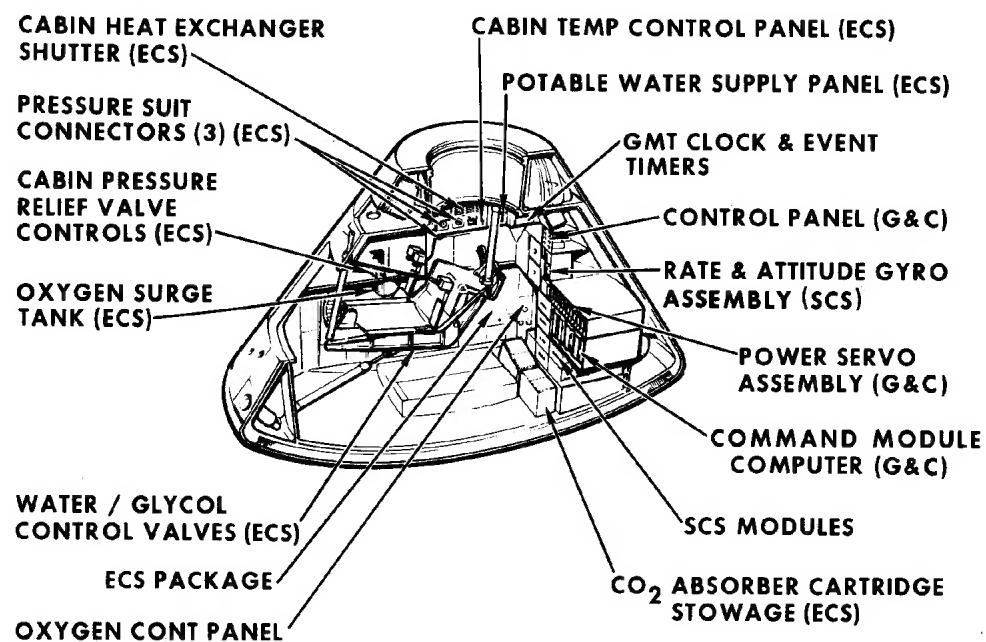
## BLOCK II




JAN 67

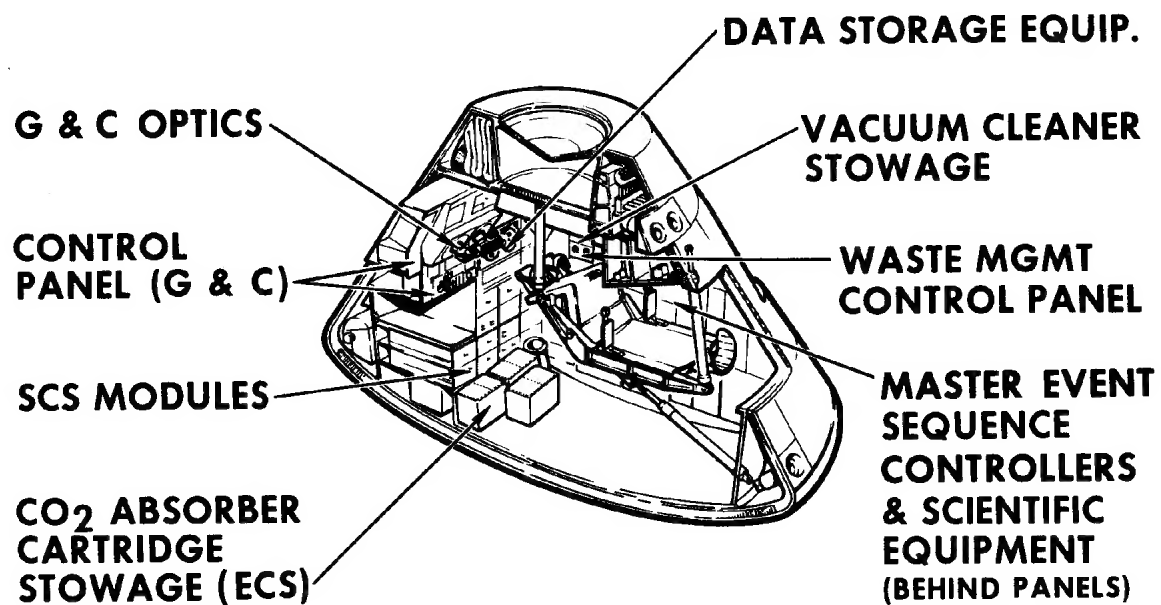
CS-7000D

## COMMAND MODULE INTERIOR (LEFT SIDE)



FAM-1007D 

## COMMAND MODULE INTERIOR (RIGHT SIDE)



COMMUNICATIONS MODULES

FAM-1008C



# APOLLO ABBREVIATIONS

A/C	AUDIO CENTER (COMM)	L/D	LIFT-OFF
ACE	ACCEPTANCE CHECKOUT EQUIP.	LOI	LUNAR ORBIT INSERTION (G&C)
ACS	ATTITUDE CONTROL SUBSYSTEM (SCS)	LOR	LUNAR ORBITAL RENDEZVOUS
A/D	ANALOG TO DIGITAL (COMM)	LOS	LINE OF SIGHT (G&N)
AGAA	ATTITUDE GYRO ACCELEROMETER ASSEMBLY (SCS)	LSC	LINEAR SHAPE CHARGE (SECS)
ARS	ATTITUDE REFERENCE SUBSYSTEM (SCS)	LV	LAUNCH VEHICLE
BMAG	BODY MOUNTED ATTITUDE GYRO (SCS)	MAX Q	MAXIMUM DYNAMIC PRESSURE
BPC	BOOST PROTECTIVE COVER (SECS)	MC	MEGACYCLES
B/P	BOILERPLATE	MDC	MAIN DISPLAY CONSOLE
CDU	COUPLING DATA UNIT (G&C)	MDF	MILD DETONATING FUSE (STRUCT)
CM	COMMAND MODULE	MESC	MASTER EVENTS SEQUENCE CONTROLLER (SECS)
CMC	COMMAND MODULE COMPUTER	MNA	MAIN BUS A (EPS)
CDAS	CREWMAN OPTICAL ALIGNMENT SIGHT (CREW)	MNB	MAIN BUS B (EPS)
COMM	COMMUNICATIONS SUBSYSTEM	MSFN	MANNED SPACE FLIGHT NETWORK (COMM)
CSM	COMMAND SERVICE MODULE	MTVC	MANUAL THRUST VECTOR CONTROL (SCS)
CTE	CENTRAL TIMING EQUIP. (COMM)	PCM	PULSE CODE MODULATION (COMM)
C/W	CAUTION & WARNING	PGA	PRESSURE GARMENT ASSEMBLY (CREW)
CWG	CONSTANT WEAR GARMENT (CREW)	PONCS	PRIMARY GUIDANCE, NAVIGATION & CONTROL SYS
D/A	DIGITAL TO ANALOG (COMM)	PIPA	PULSED INTEGRATING PENDULOUS ACCELEROMETER (G&C)
D/S	DOCKING SYSTEM	PLSS	PORTABLE LIFE SUPPORT SYSTEM (CREW)
DSE	DATA STORAGE EQUIP. (COMM)	PM	PHASE MODULATION (COMM)
DSIF	DEEP SPACE INSTRUMENTATION FACILITY (COMM)	PMP	PREMODULATION PROCESSOR (COMM)
DSKY	DISPLAY & KEYBOARD (G&C)	PRN	PSEUDO-RANDOM NOISE (COMM)
JV	DIFFERENTIAL VELOCITY (G&C)	PROP	PROPULSION
ECA	ELECTRONIC CONTROL ASSEMBLY (SCS)	PSA	POWER SERVO ASSEMBLY (G&C)
ECS	ENVIRONMENTAL CONTROL SUBSYSTEM	PTT	PUSH TO TALK (COMM)
ECU	ENVIRONMENTAL CONTROL UNIT (ECS)	RCS	REACTION CONTROL SUBSYSTEM
EDA	ELECTRONIC DISPLAY ASSEMBLY (G&C)	RGA	RATE GYRO ASSEMBLY (SCS)
EDS	EMERGENCY DETECTION SUBSYSTEM (SECS)	RJEC	REACTION JET AND ENGINE ON-OFF CONTROL (G&C)
ELS	EARTH LANDING SUBSYSTEM (SECS)	RRT	RENDEZVOUS RADAR TRANSPONDER (COMM)
EMS	ENTRY MONITOR SYSTEM	RTC	REAL TIME COMMAND (COMM)
EMU	EXTRA-VEHICULAR MOBILITY UNIT (CREW)	SBPA	S-BAND POWER AMPLIFIER (COMM)
EOI	EARTH ORBIT INSERTION (G&C)	SC	SPACECRAFT
EPS	ELECTRICAL POWER SUBSYSTEM	SCE	SIGNAL CONDITIONING EQUIPMENT (TLM)
EVA	EXTRA-VEHICULAR ACTIVITY (CREW)	SCS	STABILIZATION & CONTROL SUBSYSTEM
FC	FUEL CELL (EPS)	SCT	SCANNING TELESCOPE (G&N)
FDAI	FLIGHT DIRECTOR ATTITUDE INDICATOR (SCS)	SECS	SEQUENTIAL EVENTS CONTROL SUBSYSTEM
FHS	FORWARD HEAT SHIELD	SLA	SPACECRAFT LM ADAPTER
G&C	GUIDANCE & CONTROL	SM	SERVICE MODULE
GDC	GYRO DISPLAY COUPLER (SCS)	SPS	SERVICE PROPULSION SUBSYSTEM
GHZ	GIGAHERTZ (COMM)	SSA	SPACE SUIT ASSEMBLY (CREW)
G&N	GUIDANCE & NAVIGATION	SXT	SEXTANT (G&N)
GNCS	GUIDANCE NAVIGATION & CONTROL SYSTEM	TCA	THRUST CHAMBER ASSEMBLY (PROP)
GSE	GROUND SUPPORT EQUIP.	TEI	TRANSEARTH INJECTION (G&C)
HF	HIGH FREQUENCY (3-30MC)	TLI	TRANS-LUNAR INJECTION (G&C)
IMU	INERTIAL MEASUREMENT UNIT (G&N)	TLM	TELEMETRY (COMM)
INV	INVERTER (EPS)	TMG	THERMAL METEOROID GARMENT (CREW)
IU	INSTRUMENT UNIT (LV)	TVC	THRUST VECTOR CONTROL (SPS)
KMC	KILOMEGA CYCLES	TVSA	THRUST VECTOR POSITION SERVO AMPLIFIER (G&C)
KOH	POTASSIUM HYDROXIDE (EPS)	UDK	UP DATA LINK (COMM)
LCO	LIQUID COOLED GARMENT (CREW)	UDMH	UNSYMMETRICAL DIMETHYL HYDRAZINE (PROP)
LDC	LUNAR DOCKING EVENTS CONTROLLER (DS)	UHF	ULTRA HIGH FREQUENCY (300-3000 MC)
LEB	LOWER EQUIPMENT BAY	USBE	UNIFIED S-BAND EQUIP. (COMM)
LES	LAUNCH ESCAPE SUBSYSTEM (SECS)	VHF	VERY HIGH FREQUENCY (30-300 MC)
LET	LAUNCH ESCAPE TOWER (SECS)	WMS	WASTE MANAGEMENT SUBSYSTEM (CREW)
LM	LUNAR MODULE		